Security Administration Guide

Adaptive Server® Enterprise

15.7

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CHAPTER 1

Introduction to Security

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Introduction to security

Information is possibly your company's greatest asset. Information needs protection just like any other asset. As a system administrator, determine how best to protect the information contained in company databases, and who may access the information. Individual database servers need strong, yet flexible, security support.

Users and the data they access may be located anywhere in the world, connected by untrusted networks. Ensuring the confidentiality and integrity of sensitive data and transactions in this environment is critical.

Information is useful only if it gets to the people who need it, when they need it. With complex and dynamically changing business relationships, it is critical that information gets only to authorized users.

What is “information security?”

These are some general guidelines when considering security for your enterprise:

- Sensitive information should be kept confidential – determine which users should have access to what information.

- The system should enforce integrity – the server should enforce rules and constraints to ensure that information remains accurate and complete.
- The information should be available – even with all the safeguards in place, anybody who needs access to the information should have it available when the information is needed.

Identify what is it that your organization wants to protect, and what the outside world requires from your organization:

- Identify the information assets and the security risks associated with them if they become vulnerable or compromised.
- Identify and understand any laws, statutes, regulations, and contractual agreements that apply to your organization and the information assets.
- Identify your organization's business processes and the requirements they impose on information assets, to balance practical considerations with the security risks.

Security requirements change over time. Periodically reassess security requirements to make sure they still reflect your organization's needs.

Next, set up a series of controls and policies that meet the company's security objectives, the result of which is an information security policy document that clarifies decisions made for information security.

Adaptive Server® contains a set of security features that help you enforce your company's security policies. For more information about security features in Adaptive Server, see Chapter 2, "Getting Started with Security Administration in Adaptive Server."

Information security standards

Adaptive Server has been evaluated and validated in accordance with the provisions of the Common Criteria Evaluation and Validation Scheme. Adaptive Server also uses FIPS 140-2 certified modules for implementing encryption functionality.

This section describes these certifications.

Common Criteria configuration evaluation

Common Criteria for Information Techonology Security Evaluation is an international standard (ISO/IEC 15408) for computer security certification. Common Criteria is developed by the governments of Canada, France, Germany, Netherland, UK and the United States.

Adaptive Server version 15.0.1 completed Common Criteria validation in September, 2007. The Evaluated configuration consists of Adaptive Server version 15.0.1 with the security and directory services option. The Adaptive Server evaluation for security was carried out in accordance with the Common Criteria Evaluation and Validation Scheme (CCEVS) process and scheme. The criteria against which the Adaptive Server Enterprise was judged are described in the Common Criteria for Information Technology Security Evaluation, Version 2.3 and International Interpretations effective on August, 2005. If you configure Adaptive Server as specified in the *Supplement for Installing Adaptive Server for Common Criteria Configuration*, Adaptive Server satisfies all of the security functional requirements stated in the Sybase® Adaptive Server Enterprise Security Target (Version 1.5).

Adaptive Server supports eight security functions:

- Cryptographic support – Adaptive Server supports transparent encryption of data at the column level. SQL statements and extensions provide secure key management.
- Security audit – an audit mechanism that checks access, authentication attempts, and administrator functions. The security audit records the date, time, responsible individual, and other details describing the event in the audit trail.
- User data protection – Adaptive Server implements the discretionary access control policy over applicable database objects: databases, tables, views, stored procedures, and encryption keys.
- Identification and authentication – Adaptive Server provides its own identification and authentication mechanism in addition to the underlying operating system mechanism.
- Security management – functions that allow you to manage users and associated privileges, access permissions, and other security functions such as the audit trail. These functions are restricted based on discretionary access control policy rules, including role restrictions.

- Protection of the TOE Security Function (TSF) – Adaptive Server keeps its context separate from that of its users, and uses operating system mechanisms to ensure that memory and files used by Adaptive Server have the appropriate access settings. Adaptive Server interacts with users through well-defined interfaces designed to ensure that its security policies are enforced.
- Resource utilization – Adaptive Server provides resource limits to prevent queries and transactions from monopolizing server resources.
- Target of Evaluation (TOE) access – Adaptive Server allows authorized administrators to construct login triggers that restrict logins to a specific number of sessions and restrict access based on time. Authorized administrators can also restrict access based on user identities.

FIPS 140-2 validated cryptographic module

SSL is the standard for securing the transmission of sensitive information, such as credit card numbers, stock trades, and banking transactions over the Internet. SSL for Adaptive Server uses Certicom Security Builder GSE, a FIPS 140-2 level 1 validated cryptography module. See validation certificate #542, dated June 2, 2005 at the NIST Web site at http://csrc.nist.gov.

FIPS 140-2 certified Certicom Security Builder GSE is also used to encrypt login passwords in transmitted login packet, in memory and on disk, if the configuration parameter FIPS login password encryption is enabled.

Note A Security and Directory Services license is required to use SSL and to enable the FIPS login password encryption parameter. If the parameter is not enabled, OpenSSL security provider is used to perform login password encryption.

Adaptive Server encrypted columns feature relies on symmetric- key cryptography, and uses the same FIPS 140-2 validated cryptographic modules as SSL. See the *Users Guide for Encrypted Columns*.

Note You must have an encrypted columns license to use the Adaptive Server encrypted columns feature.

CHAPTER 2

Getting Started with Security Administration in Adaptive Server

General process of security administration

"Performing major tasks to securely administer Adaptive Server" describes the major tasks that are required to securely administer Adaptive Server and refers you to the documentation that contains the instructions for performing each task.

❖ Performing major tasks to securely administer Adaptive Server

1. Install Adaptive Server, including auditing – includes preparing for installation, loading files from your distribution medium, performing the actual installation, and administering required physical resources. See the installation documentation for your platform and Chapter 8, "Auditing."

2. Set up a secure administrative environment – Set up system administrators and system security officers, create login profiles and establish password and login policies. See Chapter 3, "Managing Adaptive Server Logins and Database Users."

3 Set up logins, database users and roles – Add user logins to the server and assign login profiles to them. Create user defined roles, define role hierarchies and mutual exclusivity of roles, and assign roles to logins. Add users to databases. See Chapter 3, "Managing Adaptive Server Logins and Database Users."

4 Administer permissions for users, groups, and roles – Grant and revoke permissions for certain SQL commands, executing certain system procedures, and accessing databases, tables, particular table columns, and views. Create access rules to enforce fine-grained access control. See Chapter 6, "Managing User Permissions."

5 Configure encryption in your database to encrypt sensitive data in tables. Encrypt sensitive data – Configure Adaptive Server to use column-level encryption, decide which columnar data to encrypt, perform a one-time key creation operation, and use alter table to perform initial data encryption. See *Users Guide for Encrypted Columns*.

6 Establish integrity controls over data – Add check constraints, domain roles, and referential constraints to validate incoming data. See *Transact-SQL Users guide* and *Reference Manual: Commands*.

7 Set up and maintain auditing – Determine what is to be audited, audit the use of Adaptive Server, and use the audit trail to detect penetration of the system and misuse of resources. See Chapter 8, "Auditing," and the Adaptive Server installation and configuration documentation for your platform.

8 Set up your installation for advanced authentication mechanisms and network security – Configure the server to use services, such as LDAP, PAM, or Kerberos- based user authentication, data confidentiality with encryption, data integrity. See Chapter 4, "External Authentication" and Chapter 7, "Confidentiality of Data."

Recommendations for setting up security

The following describes logins and how they relate to security.

- Using the "sa" login – when you install Adaptive Server, a single login called "sa" is configured with the system administrator and system security officer roles, which means that the "sa" login has unlimited control over what occurs in the database.

Use the “sa” login only during initial setup. Instead of allowing several users to use the “sa” account, establish individual accountability by assigning specific roles to individual administrators.

- Changing the “sa” login password – the “sa” login is configured initially with a “NULL” password. Use alter login to change the password immediately after installation.

Warning! When logging in to Adaptive Server, do not use the -P option of isql to specify your password because another user may have an opportunity to see it.

- Enabling auditing – enable auditing early in the administration process so that you have a record of privileged commands that are executed by system security officers and system administrators. You might also want to audit commands that are executed by those with other special roles, such as operators when they dump and load databases
- Assigning login names – assign Adaptive Server login names that are the same as their respective operating system login names. This makes logging in to Adaptive Server easier, simplifies management of server and operating system login accounts, and makes it easier to correlate the audit data generated by Adaptive Server with that of the operating system.

An example of setting up security

This uses special roles assigned to the users listed in Table 2-1.

Table 2-1: Users to whom you assign roles

Name	Privilege	Operating system login name
Rajnish Smith	sso_role	rsmith
Catherine Macar-Swan	sa_role	cmacar
Soshi Ikedo	sa_role	sikedo
Julio Rozanski	oper_role	jrozan
Alan Johnson	dbo	ajohnson

Table 2-2 shows the sequence of commands you might use to set up a secure operating environment for Adaptive Server, based on the role assignments shown in Table 2-1. After logging in to the operating system, issue these commands using the initial “sa” account.

Table 2-2: Examples of commands used to set up security

Commands	Result
• isql -Usa	Logs in to Adaptive Server as “sa.” Both sa_role and sso_role are active.
• sp_audit “security”, “all”, “all”, “on”‘ • sp_audit “all”, “sa_role”, “all”, “on” • sp_audit “all”, “sso_role”, “all”, “on”‘	Sets auditing options for server-wide, security-relevant events, and the auditing of all actions that have sa_role or sso_role active.
• sp_configure “auditing”, 1	Enables auditing.
Note Before you enable auditing, set up a threshold procedure for the audit trail and determine how to handle the transaction log in sybsecurity. See Chapter 8, “Auditing.”	
• create login	Adds logins and passwords.
• grant role	Grant roles.
• use sybsecurity • sp_changedbowner rsmith	Grants access to the auditing database, sybsecurity, by making Rajnish, who is the system security officer, the database owner. Alan is not granted any system-defined roles.
sp_locklogin sa,"lock"	Locks the “sa” login so that no one can log in as “sa.” Individuals can assume only the roles that are configured for them.

Note Do not lock the “sa” login until you have granted individual users the sa_role and sso_role roles and have verified that the roles operate successfully.

Security features in Adaptive Server

The major security features in Adaptive Server are:

- “Identification and authentication” on page 9 – ensures that only authorized users can log in to the system. In addition to password-based login authentication, Adaptive Server supports external authentication using Kerberos, LDAP, or PAM.
- “Discretionary access control” on page 10 – provides access controls that give object owners the ability to restrict access to objects, usually with the grant and revoke commands. This type of control is dependent on an object owner’s discretion.

- "Division of roles" on page 11 – allows an administrator to grant privileged roles to specified users so only designated users can perform certain tasks. Adaptive Server has predefined roles, called "system roles," such as system administrator and system security officer. In addition, Adaptive Server allows system security officers to define additional roles, called "user-defined roles."
- "Auditing for accountability" on page 12 – provides the ability to audit events such as logins, logouts, server start operations, remote procedure calls, accesses to database objects, and all actions performed by a specific user or with a particular role active. Adaptive Server also provides a single option to audit a set of server-wide security-relevant events.
- "Confidentiality of data" on page 13 – maintains confidentiality of data using encryption for client/server communication, available with Kerberos or SSL. Column-level encryption preserves confidentiality of data stored in the database. Inactive data is kept confidential with a password-protected database backup.

Identification and authentication

Adaptive Server uses the server user identity (SUID) to uniquely identify a user with a login account name. This identity is linked to a particular user identity (UID) in each database. Access controls use the identity when determining whether to allow access for the user with this SUID to an object. Authentication verifies that a user is actually the person he or she claims to be. Adaptive Server allows both internal and external mechanisms for authentication.

Identification and authentication controls are discussed in Chapter 3, "Managing Adaptive Server Logins and Database Users." In addition, see "Using proxy authorization" on page 194 and Chapter 7, "Managing Remote Servers" in *System Administration Guide, Volume I*.

External authentication

Security is often enhanced in large, heterogeneous applications by authenticating logins with a central repository. Adaptive Server supports a variety of external authentication methods:

- Kerberos – provides a centralized and secure authentication mechanism in enterprise environments that includes the Kerberos infrastructure. Authentication occurs with a trusted, third-party server called a key distribution center to verify both the client and the server.
- LDAP user authentication – Lightweight Directory Access Protocol (LDAP) provides a centralized authentication mechanism based on a user's login name and password.
- PAM user authentication – Pluggable Authentication Module (PAM) provides a centralized authentication mechanism that uses operating system interfaces for both administration and runtime application operations.

For more information about each of these methods of external authentication, see Chapter 4, "External Authentication."

Managing remote servers

Internal mechanisms for administering logins and users between Adaptive Servers are described in Chapter 7, "Managing Remote Servers" in *System Administration Guide, Volume I*.

Discretionary access control

Object owners can grant access to the objects they own to other users. Object owners can also grant other users the ability to pass the access permission to other users. With Adaptive Server discretionary access control, you can give various permissions to users, groups, and roles using the grant command. Use the revoke command to rescind these permissions. The grant and revoke commands give users permission to execute specified commands, and to access specified tables, procedures, views, encryption keys, and columns.

Some commands can be used at any time by any user, with no permission required. Others can be used only by users of a certain status, such as a system administrator, and are not transferable.

The ability to assign permissions for the commands that can be granted and revoked is determined by each user's status (as system administrator, system security officer, database owner, or database object owner), and whether a particular user is granted a permission with the option to grant that permission to other users.

Chapter 6, “Managing User Permissions.”Discretionary access control are discussed in

Row-level access control

Row-level access control provides a powerful and flexible means of protecting data, down to the row level. Administrators define access rules that are based on the value of individual data elements, and the server transparently enforces these rules. Once an administrator defines an access rule, it is automatically invoked whenever the affected data is queried through applications, ad hoc queries, stored procedures, views, and so on.

Using a rule-based access control simplifies both the security administration of an Adaptive Server installation and the application development process because the server, rather than the application, enforces security. These features allow you to implement row-level access control:

- Access rules
- Application context facility
- Login triggers
- Domain integrity rules

See “Using row-level access control” on page 214.

Division of roles

The roles supported by Adaptive Server enable you to enforce and maintain individual accountability. Adaptive Server provides system roles, such as system administrator and system security officer, and user-defined roles, which are created by a system security officer.

Roles are collections of privileges that allow the role assignee to do their job. Roles provide individual accountability for users performing operational and administrative tasks, and allow you to audit and attribute actions to these users.

Role hierarchy

A system security officer can define role hierarchies such that if a user has one role, the user automatically has roles lower in the hierarchy. For example, the "chief_financial_officer" role might contain both the "financial_analyst" and the "salary_administrator" roles. The chief financial officer can perform all tasks and see all data that can be viewed by salary administrators and financial analysts.

Mutual exclusivity

You can define roles to be mutually exclusive either at the membership level, or at the activation level. For example:

- You may not want to grant both the "payment_requestor" and "payment_approver" roles to the same user.
- A user might be granted both the "senior_auditor" and the "equipment_buyer" roles, but you may not want to permit the user to have both roles enabled at the same time.

You can define system roles, as well as user-defined roles, to be in a role hierarchy or to be mutually exclusive. For example, you might want a "super_user" role to contain the system administrator, operator, and technical support roles. Additionally, you may want to define the system administrator and system security officer roles to be mutually exclusive for membership; that is, a single user cannot be granted both roles.

See "Creating and assigning roles to users" on page 151.

Auditing for accountability

Adaptive Server includes a comprehensive auditing system. The auditing system consists of:

- The sybsecurity database
- Configuration parameters for managing auditing
- sp_audit to set all auditing options
- sp_addauditrecord to add user-defined records to the audit trail

When you install auditing, you can specify the number of audit tables that Adaptive Server uses for the audit trail. If you use two or more tables to store the audit trail, you can set up a smoothly running audit system with no manual intervention and no loss of records.

A system security officer manages the audit system and is the only user who can start and stop auditing, set up auditing options, and process the audit data. As a system security officer, you can establish auditing for events such as:

- Server-wide, security-relevant events
- Creating, dropping, and modifying database objects
- All actions by a particular user or all actions by users with a particular role active
- Granting or revoking database access
- Importing or exporting data
- Logins and logouts
- All actions related to encryption keys

Auditing functionality is discussed in Chapter 8, "Auditing."

Confidentiality of data

Adaptive server allows you to maintain the confidentiality of data by encrypting client-server communications using the Secure Sockets Layer (SSL) standard or using Kerberos. You can protect the confidentiality of data by using column-level encryption in the database and encrypting backups for offline data The dump and load database commands include a *password* parameter that allows you to password-protect your database dumps.

For more information see:

- SSL – Chapter 7, "Confidentiality of Data"
- Kerberos – Chapter 4, "External Authentication"
- Encrypted columns – *Encrypted Columns Users Guide*
- Dumps and loads – *Reference Manual: Commands* and Chapter 12, "Backing Up and Restoring User Databases," in *System Administration Guide: Volume 2*

CHAPTER 3

Managing Adaptive Server Logins and Database Users

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Introduction to logins and login profiles

A login defines a name and a password for a user to allow access to Adaptive Server. When you execute create login, Adaptive Server adds a row to master.dbo.syslogins, assigns a unique system user ID (suid) for the new user, and fills in specified attribute information. When a user logs in, Adaptive Server looks in syslogins for the name and password provided by the user. The password column is encrypted with a one-way algorithm so it is not readable.

A login profile is a collection of attributes to be applied to a set of login accounts. The attributes define login characteristics, such as default roles or the login script associated with each login bound to the profile. Login profiles save save time for the system security administrator because attributes of login accounts are set up and managed in one place.

Managing login accounts

The responsibility of adding new login accounts to Adaptive Server, adding users to databases, and granting users permission to use commands and access database objects is divided among the system security officer, system administrator, and database owner.

Table 3-1 summarizes the system procedures and commands used to create and manage login accounts.

Table 3-1: Managing users in Adaptive Server

Task	Required role	Command or procedure	Database, group, or role
Create login accounts	System security officer	create login	Master database
Alter login accounts	System security officer The exception is that users can change their own password and fullname.	alter login	Master database
Drop login accounts	System security officer	drop login	Master database
Create groups	Database owner or system administrator	sp_addgroup	User database
Create and assign roles	System security officer	create role, grant role	Master database
Add users to database and assign groups	Database owner or system administrator	sp_adduser	User database

Task	Required role	Command or procedure	Database, group, or role
Alias users to other database users	Database owner or system administrator	sp_addalias	User database
Grant groups, users, or roles permission to create or access database objects and run commands	Database owner, system administrator, system security officer, or object owner	grant	User database

Creating login accounts

The following steps describe creating a login account for a particular server and manage permissions for the users.

1. A system security officer creates a login account for a new user.
2. A system administrator or database owner adds a user to database or assigns a user to a group.
3. A system security officer grants specific roles to the user.
4. A system administrator, database owner, or object owner grants the user, or group specific permissions on specific commands and database objects.

Use create login to add a new login name to Adaptive Server. Only the system security officer can execute create login.

See create login in the *Reference Manual: Commands* for complete syntax.

At login creation, the crdate column in syslogins is set to the current time.

The suid column in syslogins uniquely identifies each user on Adaptive Server. A user's suid remains the same, no matter what database he or she is using. The suid 1 is always assigned to the default "sa" account that is created when Adaptive Server is installed. Other users' server user IDs are integers assigned consecutively by Adaptive Server each time create login is executed.

For information about choosing passwords, see Choosing and creating a password.

The following statement sets up an account for the user "maryd" with the password "100cents," the default database (master), the default language (us_english), and no full name:

```
create login maryd with password "100cents"
```

The password requires quotation marks because it begins with 1.

After this statement is executed, “maryd” can log in to Adaptive Server. She is automatically treated as a “guest” user in master, with limited permissions, unless she has been specifically given access to master.

The following statement sets up a login account “omar_khayyam” and password “rubaiyat” and makes “pubs2” the default database for this user:

```
create login omar_khayyam with password rubaiyat
default database pubs2
```

Last login and managing inactive accounts

Adaptive Server provides security for user accounts by:

- Tracking the creation date.
- Recording the last login time for an account.
- Determining which accounts are stale and locked due to inactivity.
- Recording the reason an account is locked, when the account is locked, and the identity of the user who locked the account.

Defining a stale period

stale period is an attribute of login profiles which indicates the duration a login account is allowed to remain inactive before being locked due to inactivity. If the login profile track lastlogin attribute is not set to 0 and the login account is not exempt from locking due to inactivity, then the syslogins.lastlogindate and syslogins.pwdate fields are checked to determine inactivity during the login process or during the execution of sp_locklogin.

When login accounts are locked due to in activity, the locksuid, lockreason and lockdate fields in syslogins will be set as follows:

Value of lockreason	Value for locksuid	Description of lockreason of account
4	NULL	Account locked automatically due to inactivity.

If a High Availability solution is setup, the syslogins.lastlogindate and syslogins.pwdate are synchronized on both the servers. Login accounts locked on one server are also locked on the companion server.

Tracking the last login

Tracking of the last login date time can be set through the track lastlogin attribute of a login profile.

```
create login profile general_lp with track lastlogin
true authenticate with ASE
```

Preventing inactive accounts from being locked

Login accounts can be set to be exempt login from being locked due to inactivity be using the exempt inactive lock clause.

The following statement creates the login account “user33” which is exempt from being lock due to inactivity.

```
create login user33 with password AT0u7gh9wd exempt
inactive lock true
```

Authentication mechanisms for login

The supported authentication mechanisms are: ASE, LDAP, PAM, KERBEROS, and ANY.

When ANY is used, Adaptive Server checks for a defined external authentication mechanism. If one is defined, Adaptive Server uses the defined mechanism., otherwise the ASE mechanism is used.

Changing login accounts

Use alter login to add, drop or change attributes of a login and their corresponding values. alter login allows you to:

- Add or drop auto activated roles
- Change a password
- Change the login profile association
- Change or add a full name
- Specify the password expiration and the minimum password length
- Specify the maximum failed attempts

- Specify an authentication mechanism
- Specify the default language and default database
- Invoke a login script
- Exempt inactive login accounts

A system administrator can use alter login to set password length and expiration, to limit failed login attempts, drop attributes, and to specify that a login script be run automatically when a user logs in.

After you execute alter login to change the default database, the user is connected to the new default database the next time he or she logs in. However, alter login does not automatically give the user access to the database. Unless the database owner has been assigned access with sp_adduser, sp_addalias, or with a guest user mechanism, the user is connected to master even after his or her default database has been changed.

This example changes the default database for the login account anna to pubs2:

```
alter login anna modify default database pubs2
```

This example changes the default language for claire to French:

```
alter login claire modify default language french
```

Dropping login accounts

The command drop login removes an Adaptive Server user login by deleting the user's entry from master.dbo.syslogins.

You cannot drop a login who is a user in any database, and you cannot drop a user from a database if the user owns any objects in that database or has granted any permissions on objects to other users.

The dropped login account's server user ID (suid) can be reused when the next login account is created. This only occurs when the dropped login holds the highest suid in syslogins , but could compromise accountability if execution of drop login is not being audited.

You cannot drop the last remaining System Security Officer's or System Administrator's login account.

The with override clause drops the login even if there are non-available databases that cannot be checked for login references.

The following example drops login accounts mikeb and rchin.

```
drop login mikeb, rchin
```

See the *Reference Manual: Commands* for complete drop login syntax.

Choosing and creating a password

The system security officer assigns each user a password using create login when adding the user to Adaptive Server. Users can modify their passwords at any time using the alter login statement. See “Changing passwords” on page 79.

When you create your password:

- Do not use information such as your birthday, street address, or any other word or number that has anything to do with your personal life.
- Do not use names of pets or loved ones.
- Do not use words that appear in the dictionary or words spelled backwards.

The most difficult passwords to guess are those that combine uppercase and lowercase letters and numbers. Never give anyone your password, and never write it down where anyone can see it.

Passwords must:

- Be at least 6 characters long. Sybase recommends passwords of 8 characters or longer.
- Consist of any printable letters, numbers, or symbols.
- Be enclosed in quotation marks in create login if they:
  - Includes any character other than A – Z, a – z, 0 – 9,_, #, valid single-byte or multibyte alphabetic characters, or accented alphabetic characters
  - Begin with a number 0 – 9

See “Password complexity checks” on page 27.

Setting and changing the maximum login attempts

Setting the maximum number of login attempts allowed provides protection against "brute-force" or dictionary-based attempts to guess passwords. A system security officer can specify a maximum number of consecutive login attempts allowed, after which the login or role is automatically locked. The number of allowable failed login attempts can be set for the entire server, or for individual logins and roles. Individual settings override the server-wide setting.

The number of failed logins is stored in the logincount column in master..syslogins. A successful login resets the number of failed logins to 0.

❖ Setting the server-wide *maximum failed logins*

By default, maximum failed logins is turned off and this check is not applied to passwords. Use sp_passwordpolicy to set server-wide maximum number of failed logins for logins and roles.

- To set the number of failed logins allowed, enter:

```
sp_passwordpolicy 'set', 'maximum failed logins',
'number'
```

See sp_passwordpolicy in *Reference Manual: Procedures*.

❖ Setting the *maximum failed logins* for specific logins

- To set the maximum number of failed login attempts for a specific login at creation, use create login.

This example creates the new login "joe" with the password "Djdiek3" and sets the maximum number of failed login attempts to 3:

```
create login joe with password Djdiek3 max failed
attempts 3
```

See create login in *Reference Manual: Commands*.

❖ Setting the *maximum failed logins* for specific roles

- To set the maximum failed logins for a specific role at creation, use create role.

This example creates "intern_role" with the password "temp244", and sets the maximum failed logins for "inter_role" to 20:

```
create role intern_role with passwd "temp244", maximum
failed logins 20
```

See create role in *Reference Manual: Commands*.

❖ **Changing the *maximum failed logins* for specific logins**

- Use alter login to set or change the maximum failed logins for an existing login.

Changes the maximum failed logins for the login "joe" to 40:

```
alter login joe max failed attempts 40
```

❖ **Changing the *maximum failed logins* for specific roles**

- Use alter role to set or change the maximum failed logins for an existing role.

This example changes the maximum failed logins allowed for "physician_role" to 5:

```
alter role "all overrides" set maximum failed logins -1
```

This example removes the overrides for the maximum failed logins for all roles:

```
alter role physician_role set maximum failed logins 5
```

For details on the syntax and rules for using maximum failed logins, see alter role in *Reference Manual: Commands*.

Logging in after losing a password

Use the dataserver -p*login_name* parameter to specify the name of the system security officer or system administrator at the server start-up. This allows you to set a new password for these account if there is no way to recover a lost password.

When you start with the -p parameter, Adaptive Server generates, displays, and encrypts a random password and saves it in master..syslogins as that account's new password.

You can use dataserver -p to reset the password for sa_role and sso_role. Use dataserver -p when you have lost the password for either of these roles, that require a password to become active.

For example, if the server is started with:

```
dataserver -psa_role
```

Adaptive Server displays this message:

```
New password for role 'sa_role' : qjcdyrbfkxgyc0
```

If sa_role does not have a password, and it is started with -psa_role, Adaptive Server prints an error message in the error log.

Sybase strongly recommends that you change the password for the login or role when the server restarts.

Displaying password information

This section discusses how to display password information for logins and roles.

❖ Displaying password information for specific logins

- Use sp_displaylogin to display the login and password settings for a login.

This example displays information about the login joe which is bound to a login profile:

```
sp_displaylogin joe
Suid: 3
Loginame: joe
Fullname: Joe Williams
Configured Authorization:
      sa_role (default ON)
      sso_role (default ON)
      oper_role (default ON)
Locked: NO
Date of Last Password Change: Sep 22 2008  3:50PM
Password expiration interval: 0
Password expired: NO
Minimum password length: 6
Maximum failed logins: 1
Current failed login attempts: 2
Authenticate with: ANY
Login Profile: emp_lp
```

This example displays information about the login joe which is not bound to a login profile:

```
sp_displaylogin joe
Suid: 3
Loginame: joe
Fullname:
Default Database: master
Default Language:
Auto Login Script:
Configured Authorization:
Locked: NO
Date of Last Password Change: Sep 22 2008  3:50PM
```

```
Password expiration interval: 0
Password expired: NO
Minimum password length: 6
Maximum failed logins: 1
Current failed login attempts: 2
Authenticate with: ANY
Login Password Encryption: SHA-256
Last login date: Sep 18 2008 10:48PM
```

See sp_displaylogin in *Reference Manual: Procedures*.

❖ **Displaying password information for specific roles**

- Use sp_displayroles to display the login and password settings for a role.

This example displays information about the physician_role role:

```
sp_displayroles physician_role, "display_info"
Role name = physician_role
Locked : NO
Date of Last Password Change : Nov 24 1997  3:35PM
Password expiration interval = 5
Password expired : NO
Minimum password length = 4
Maximum failed logins = 10
Current failed logins = 3
```

See sp_displayroles in *Reference Manual: Procedures*.

Checking passwords for at least one digit

The system security officer can instruct the server to check for at least one digit in a password using the server-wide configuration parameter, check password for digit. If set, this parameter does not affect existing passwords. By default, checking for digits is off.

This example activates the check password functionality:

```
sp_configure "check password for digit", 1
```

This deactivates the check password functionality:

```
sp_configure "check password for digit", 0
```

See sp_configure in *Reference Manual: Procedures*.

Setting and changing *minimum password length*

The configurable password allows you to customize passwords to fit your needs such as using four-digit personal identification numbers (PINs) or anonymous logins with NULL passwords.

Note Adaptive Server uses a default value of 6 for minimum password length. Sybase recommends that you use a value of 6 or more for this parameter.

The system security officer can specify:

- A globally enforced minimum password length
- A per-login or per-role minimum password length

The per-login or per-role value overrides the server-wide value. Setting minimum password length affects only new passwords created after setting the value.

❖ **Setting *minimum password length* for a specific login**

- To set the minimum password length for a specific login at creation, use create login.

This example creates the new login "joe" with the password "Djdiek3", and sets the minimum password length for "joe" to 8:

```
create login joe Djdiek3 with password @minpwdlen min
password length 8
```

See create login in *Reference Manual: Commands*.

❖ **Setting *minimum password length* for a specific role**

- To set the minimum password length for a specific role at creation, use create role.

This example creates the new role "intern_role" with the password "temp244" and sets minimum password length for "intern_role" to 0:

```
create role intern_role with passwd "temp244", min
passwd length 0
```

The original password is seven characters, but the password can be changed to one of any length because minimum password length is set to 0.

See create role in *Reference Manual: Commands*.

❖ **Changing *minimum password length* for a specific login**

- Use alter login to set or change minimum password length for an existing login.

This example changes minimum password length for the login “joe” to 8 characters.

```
alter login joe modify min password length 8
```

See alter login in *Reference Manual: Commands*.

❖ **Changing *minimum password length* for a specific role**

- Use alter role to set or change minimum password length for an existing role.

This example sets the minimum length for “physician_role”, an existing role, to 5 characters:

```
alter role physician_role set min passwd length 5
```

This example overrides the minimum password length for all roles:

```
alter role "all overrides" set min passwd length -1
```

See alter role in *Reference Manual: Commands*.

❖ **Removing *minimum password length* for a specific login**

- Use alter login to remove the minimum password length for an existing login.

This example removes any restriction to minimum password length for login joe:

```
alter login joe modify drop min password length
```

See alter login in *Reference Manual: Commands*.

Password complexity checks

You can use these options, which support password complexity checks, in a stored procedure interface; their values are stored in the master.dbo.sysattributes table.

To turn off an individual option, enter:

sp_passwordpolicy 'clear', *option*

To turn off all password policy options, enter:

sp_passwordpolicy 'clear'

Login password complexity checks are also extended to role passwords. See "Login password policy checks to role passwords" on page 170.

See *Reference Manual: Procedures* for the complete sp_passwordpolicy syntax.

Disallowing simple passwords

disallow simple password checks to see if the password contains the login name as a substring. You can set it to:

- 0 – (default) turns off the option, and allows simple passwords.
- 1 – turns the option on, and disallows simple passwords.

To set this option, enter:

```
sp_passwordpolicy 'set', 'disallow simple passwords',
      '1'
```

Custom password-complexity checks

Adaptive Server allows you to custom-configure password checking rules using sp_extrapwdchecks and sp_cleanpwdchecks.

These stored procedures are defined and located in the master database and are automatically invoked during Adaptive Server password complexity checks, and when dropping a login, respectively. See "Enabling custom password checks" on page 33 for an example of how to create these custom stored procedures.

Specifying characters in a password

Use these sp_passwordpolicy parameters to specify the minimum number of characters (digits, upper and lower characters, and so on) in a password:

- min digits in password – the minimum number of digits in a password. Disabled by default. Valid values are:
    - 0 through 16 – the minimum number of digits that must exist in a password.
    - -1 – the password cannot contain digits.
- min alpha in password – the minimum number of alphabetic characters allowed in a password. This value must be at least the sum of minimum number of uppercase characters and minimum number of lowercase characters. Disabled by default. Valid values are:

  - 0 through 16 – the minimum number of special characters required for a password.
  - -1 – the password cannot contain special characters.
- min special char in password – the minimum number of special characters for a password. Valid values are:
  - 0 through 16 – the minimum number of special characters required for a password.
  - -1 – the password cannot contain special characters.
- min upper char in password – the minimum number of uppercase letters for a password. Disabled by default. Valid values are:
  - 0 through 16 – the number of uppercase letters required for a password.
  - -1 – the password cannot contain uppercase characters.
- min lower char in password – the minimum number of lowercase letters for a password. Valid values are:
  - 0 through 16 – the number of uppercase letters required for a password.
  - -1 – the password cannot contain uppercase characters.
- minimum password length – the minimum password length. You can set a minimum password length from 0 to 30. The value you specify with must be at least the sum of all other minimum requirements. For example, minimum password length must be set to at least 10 if you have set:
  - minimum digits in password to 3
  - minimum special characters in password to 2
  - minimum uppercase characters in password to 2
  - minimum lowercase characters in password to 3
- password expiration – the number of days a password can exist before it expires. You specify this value on a global basis. Disabled by default. Valid values are:
  - 0 – the password will never expire.
  - 1 through 32767 – the number of days the password can exist without expiring.

- password exp warn interval – the number of days before a password expires that the password expiration warning messages displays. These messages display with every successful login until the password is changed or it expires. This value must be less than or equal to the password expiration. Disabled by default.

  Valid values are 0 to 365.

- maximum failed logins – the maximum number of failed logins that can occur before the login is locked. Specify this value globally. Disabled by default. Valid values are:
  - 0 – logins are never locked, regardless of the number of failed login attempts.
  - 1 through 32767 – the number of failed logins that can occur before the login is locked.
- expire login changes the login status to expired when a system security officer creates or resets a login. The login is then required to change the password on the first login. Disabled by default. Valid values are:
  - 0 – new or reset logins will not expire.
  - 1 – new or reset logins expire; you must reset your password at the first login.

See sp_passwordpolicy in the *Reference Manual: Procedures*.

Password complexity option cross-checks

Some password complexity options have interaction implications:

- minimum password length must be at least the sum of min digits in password, min alpha in password, and min special characters in password.
- min alpha in password must be at least the sum of min upper char in password and min lower char in password.
- systemwide password expiration must be greater than password exp warn interval.

For the purpose of the above cross-checks, if Adaptive Server encounters a password complexity option value of -1, it interprets that as a value of 0. If an option is not set, Adaptive Server interprets the option value to be 0 as well.

Adaptive Server prints warnings for each new password complexity option that fails to satisfy the cross-checks. Option setting, however, is successful.

Setting password complexity checks

Table 3-2: Password complexity checks

Password checks and policies for Adaptive Server authentication	Configuration parameters specified using sp_configure	Password complexity options specified using sp_passwordpolicy	Per-login overrides specified using alter login
Password expiration	system-wide password expiration	system-wide password expiration	password expiration
Digits in password	check password for digit	min digits in password	N/A
Alphabetic characters in password	N/A	min alpha in password	N/A
Password length	minimum password length	minimum password length	min passwd length
Failed logins lockout	maximum failed logins	maximum failed logins	max failed attempts
Disallow simple passwords	N/A	disallow simple passwords	N/A
Special characters in password	N/A	min special char in password	N/A
Uppercase letters in password	N/A	min upper char in password	N/A
Lowercase letters in password	N/A	min lower char in password	N/A
Password expiration warning interval	N/A	password exp warn interval	N/A
Resetting your password at first login	N/A	expire login	N/A
Custom password complexity checks	N/A	N/A	N/A

Set the password complexity options at the:

- Login level using create login or alter login.
- Global level using the new sp_passwordpolicy or sp_configure.

Because you can set password configuration options on a global and per-login basis, and using old and new parameters, the order of precedence in which the password options is applied is important.

When applying password options, the order of precedence is:

1. Existing per-login parameters
2. Password complexity options
3. Existing global password options

Examples

Example 1 Creates a new login and sets the minimum password length for “johnd” to 6:

```
create login johnd with password complex_password min
      password length '6'
```

These global options for login “johnd” create two minimum password length requirements for login “johnd”, and sets restrictions about digits in the password:

```
sp_configure 'minimum password length', '8'
sp_configure 'check password for digit', 'true'
sp_passwordpolicy 'set', 'min digits in password', '2'
```

If you then try to alter the password for login “johnd”:

```
alter login johnd with password complex_password modify
password 'abcd123'
```

Adaptive Server checks the password in the following order:

1 Per-login existing options check: minimum password length must be greater than 6. This is true and the check passes.

2 New options: minimum digits in password must be greater than 2. This is true and the check passes.

3 Existing global options: minimum password length specified here is not checked because there is already a per-login check for the login “johnd”.

4 The check password for digit option is redundant because it is already checked when the minimum number of digits is turned on and set to 2.

Once Adaptive Server checks the designated sequence, and the new password for login “johnd” passes these checks, the password is successfully change.

Example 2 If you enter the following for user “johnd”, Adaptive Server first checks the per-login existing options, and determines the minimum password length is set to 6, but that you have attempted to alter the password to use only 4 characters:

```
alter login johnd with password complex_password modify
      password abcd
```

The check fails, and Adaptive Server prints an error message. Once one password complexity check fails, no additional options are checked.

Example 3 Creates a new login with the following password configuration options and sets the minimum password length for login `johnd` to 4:

```
create login johnd with password complex_password min
      password length 4
```

This is a per-login, existing option. When you add the following, you have created a global requirement that the minimum number of digits for a password must be 1:

```
sp_passwordpolicy 'set', 'min digits in password', '1'
```

If you then attempt to alter the password for login `johnd` as follows:

```
alter login johnd with password complex_password modify
      password abcde
```

Adaptive Server performs the checks in the following order:

1 Per-login existing options check: the minimum password length of a new password is 4. The password "abcde" is greater than 4, so this check passes.

2 New global requirement check: the minimum digits in a password is set to 1, globally. This check fails.

Adaptive Server does not change the password and prints an error message.

To alter a password, all the checks must pass.

Enabling custom password checks

Adaptive Server allows a system security officer to write user-defined stored procedures that enable custom password checks.

For example, to implement password history checks, create a new user table to store password histories:

```
create table pwdhistory
(
      name varchar(30)not null,  -- Login name.
      password varbinary(30)not null,  -- old password.
      pwdate datetime not null,  -- datetime changed.
      changedby varchar(30)not null  -- Who changed.
)
go
```

This user-defined stored procedure (sp_extrapwdchecks) can be called when specifying a new password to save it in an encrypted form in the pwdhistory table:

```
create proc sp_extrapwdchecks
(
@caller_password varchar(30), -- the current password of caller
```

```
@new_password    varchar(30), -- the new password of the target acct
@loginame        varchar(30), -- user to change password on
)
as

begin
declare @current_time    datetime,
        @encrypted_pwd   varbinary(30),
        @changedby       varchar(30),
        @cutoffdate      datetime


select @changedby = suser_name()

-- Change this line according to your installation.
-- This keeps history of 12 months only.
select @current_time = getdate(),
       @cutoffdate = dateadd(month,-12,getdate())
select @encrypted_pwd = hash(@new_password, 'sha1')

delete master..pwdhistory
    where  name = @loginame
    and    pwdate < @cutoffdate

if not exists ( select 1 from master..pwdhistory
                where name = @loginame
                and   password = @encrypted_pwd )
begin
      insert master..pwdhistory
      select @loginame, hash(@new_password, 'sha1'),
             @current_time, @changedby
      return (0)
end
else
begin
      raiserror 22001  --user defined error message
end
end
```

Use sp_addmessage to add the user-defined message 22001. A `raiserror 22001` indicates a custom password-complexity check error.

The following user-defined stored procedure (sp_cleanpwdchecks) can be used to clean-up the password history using sp_extrapwdchecks.

```
create proc sp_cleanpwdchecks
(
```

```
              @loginame      varchar(30)
                          -- user to change password on
)
as
begin

delete master..pwdhistory
where name = @loginame
end
      go
```

Once the two procedures above are defined and installed in the master database, they are called dynamically during the password complexity checks.

Setting the login and role expiration interval for a password

System administrators and system security officers can:

Use	To
create login	Specify the expiration interval for a login password at creation.
alter login	Change the expiration interval for a login password.
create role	Specify the expiration interval for a role password at creation (only the system security officer can issue create role).
alter role	Change the expiration interval for a role password (only the system security officer can issue alter role).

These rules apply to password expiration for logins and roles:

- A password expiration interval assigned to individual login accounts or roles overrides the global password expiration value. This allows you to specify shorter expiration intervals for sensitive accounts or roles, such as system security officer passwords, and more relaxed intervals for less sensitive accounts such as an anonymous login.
- A login or role for which the password has expired is not directly activated.
- The password expires at the time of day when the password was last changed after the number of days specified by password expiration interval has passed.

For details on the syntax and rules for the commands and system procedures, see the appropriate *Reference Manual*.

Password expiration turned off for pre-12.x passwords

Password expiration did not affect roles in versions earlier than Adaptive Server 12.x. In Adaptive Server 12.x and later, password expiration is deactivated for any existing user-defined role passwords.

Circumventing password protection

Circumventing the password-protection mechanism may be necessary in automated login systems. You can create a role that can access other roles without passwords.

A system security officer can bypass the password mechanism for certain users by granting the password-protected role to another role, and grant the password-protected role to one or more users. Activation of this role automatically activates the password-protected role without having to provide a password.

For example:

Jane is the system security officer for ABC Inc., which uses automated login systems. Jane creates the following roles:

- financial_assistant

  ```
  create role financial_assistant with passwd "L54K3j"
  ```

- accounts_officer

  ```
  create role accounts_officer with passwd "9sF6ae"
  ```

- chief_financial_officer

  ```
  create role chief_financial_officer
  ```

Jane grants the roles of financial_assistant and accounts_officer to the chief_financial_officer role:

```
grant role financial_assistant, accounts_officer to
chief_financial_officer
```

Jane then grants the chief_financial_officer role to Bob:

```
grant role chief_financial_officer to bob
```

Bob logs in to Adaptive Server and activates the chief_financial_officer role:

```
set role chief_financial_officer on
```

The roles of financial_assistant and accounts_officer are automatically activated without Bob providing a password. Bob can now access everything under the financial_assistant and accounts_officer roles without having to enter the passwords for those roles.

Creating a password expiration interval for a new login

Use create login to set the password expiration interval for a new login.

This example creates the new login “joe” with the password “Djdiek3”, and sets the password expiration interval for “joe” to 2 days:

```
create login joe with password Djdiek3 password
expiration 30
```

The password for “joe” expires after 30 days from the time of day the login account was created, or 30 days from when the password was last changed.

See create login in *Reference Manual: Procedures*.

Creating a password expiration interval for a new role

Use create role to set the password expiration interval for a new role.

This example creates the new role intern_role with the password “temp244”, and sets the password expiration interval for intern_role to 7 days:

```
create role intern_role with passwd "temp244", passwd expiration 7
```

The password for intern_role expires after 7 days from the time of day you created the role, or 2 days from when the password was last changed.

See create role in *Reference Manual: Commands*.

Creation date added for passwords

Passwords are stamped with a creation date equal to the upgrade date of a given server. The creation date for login passwords is stored in the pwdate column of syslogins. The creation date for role passwords is stored in the pwdate column of syssrvroles.

Changing or removing password expiration interval for login or role

Use alter login to change the password expiration interval for an existing login, add a password expiration interval to a login that did not have one, or remove a password expiration interval. alter login only effects login passwords, not role passwords.

This example changes the password expiration interval for the login “joe” to 5 days:

```
alter login joe modify password expiration 30
```

The password expires 30 days from the time of day you ran password expiration.

See alter login in *Reference Manual: Commands*.

Securing login passwords on the network

Adaptive Server allows the use of asymmetric encryption to securely transmit passwords from client to server using the RSA public key encryption algorithm. Adaptive Server generates the asymmetric key pair and sends the public key to clients that use a login protocol. For example, the client encrypts the user’s login password with the public key before sending it to the server. The server decrypts the password with the private key to begin the authentication of the client connecting.

You can configure Adaptive Server to require clients to use a login protocol. Set the Adaptive Server configuration parameter net password encryption reqd to require all user name- and password-based authentication requests to use RSA asymmetric encryption. See "net password encryption required", in Chapter 5, "Setting Configuration Parameters" in the *System Administration Guide: Volume 1*.

Generating an asymmetric key pair

Adaptive Server generates a new key pair:

- At each server start-up,
- Automatically at 24-hour intervals using the Adaptive Server housekeeper mechanism, and
- When an administrator with sso_role requests key pair regeneration.

The key pair is kept in memory. A message is recorded in the error log and in the audit trail when the key pair is regenerated.

To generate the key pair on demand, use:

```
sp_passwordpolicy "regenerate keypair"
```

Note Depending on the system load, there may be a delay between the time this command is executed and the time the key pair is actually generated. This is because the housekeeper task runs at a low priority and may be delayed by higher priority tasks.

To generate the key pair at a specific time, use:

sp_passwordpolicy "regenerate keypair", *datetime*

where *datetime* is the date and time you want to regenerate the key pair.

For example, a datetime string of “Jan 16, 2007 11:00PM” generates the key pair at the specified time. The datetime string can also just be a time of day, such as “4:07a.m.”. When only time of day is specified, key-pair regeneration is scheduled for that time of day in the next 24-hour period.

sp_passwordpolicy lets you configure the frequency of key-pair regeneration, as well as what Adaptive Server should do when a key pair generation fails:

- ‘keypair regeneration period’, { ([*keypair regeneration frequency*], datetime of first generation) | (keypair regeneration frequency, [*datetime of first generation*]) }
- “keypair error retry [wait | count]”, “*value*”

See sp_passwordpolicy in *Reference Manual: System Procedure*.

Server option "net password encryption"

Adaptive Server also acts as a client when establishing a remote procedure call (RPC).

When connecting to remote servers, Adaptive Server uses the net password encryption option to determine whether it will use password encryption.

Adaptive Server uses either RSA or Sybase proprietary algorithms when this server option is set to true. The command to enable net password encryption is:

```
sp_serveroption server, "net password encryption",
    "true"
```

The setting is stored in master..sysservers and you can display the value of server options using the sp_helpserver stored procedure.

The default value for net password encryption is true for any new server added using sp_addserver. During upgrade, Adaptive Server sets net password encryption to true for sysservers entries with an ASEnterprise class value. No other server classes are modified. This improves password security between two communicating Adaptive Servers.

Note The administrator can optionally reset net password encryption to false if you encounter problems establishing a connection to a server. However, if the option is set to false, passwords are transmitted in clear text on the network.

Backward compatibility

- Sybase recommends that you use the RSA algorithm to protect passwords on the network.
- To use the RSA algorithm, you must have Adaptive Server version 15.0.2 and new Connectivity SDK clients (version 15.0 ESD #7 and later.) Sybase provides the net password encryption reqd configuration parameter and the net password encryption server option to allow settings equivalent to versions earlier than 15.0.2 and maintain backward compatibility with older clients and older servers.
- Older clients that do not support the RSA algorithm can set the property to encrypt passwords using the Sybase proprietary algorithm, which has been available version 12.0. Adaptive Server then uses the Sybase proprietary algorithm.
- New clients that support both RSA and Sybase proprietary algorithms can set properties for both algorithms. When communicating with such clients, Adaptive Server 15.0.2 uses RSA encryption. A pre-15.0.2 Adaptive Server uses the Sybase proprietary algorithm.

Securing login passwords stored on disk and in memory

Login passwords used by Adaptive Server to authenticate client connections are stored securely on disk as SHA-256 hash digest. The SHA-256 algorithm is a one-way encryption algorithm. The digest it produces cannot be decrypted, making its storage on disk secure. To authenticate the user connection, the SHA-256 algorithm is applied to the password sent by the client, and the result compared with the value stored on disk.

To prevent dictionary-based attacks on login passwords stored on disk, a salt is mixed with the password before the SHA-256 algorithm is applied. The salt is stored along with the SHA-256 hash, and used during login authentication.

Sybase recommends using only SHA-256 as soon as you are certain that there will be no downgrades to an earlier versions. Consider the trade-offs when making this decision; should there be a need to downgrade to a pre-15.0.2 release, it requires administrator intervention to unlock user login passwords.

Character set considerations for passwords

Passwords and other sensitive data that is encrypted must determine the character set of the clear text to accurately interpret the result when it is decrypted, or when hash values are compared during authentication.

For example, a client connects to Adaptive Server using isql and establishes a new password. Regardless of the character set used in the client, characters are always converted to the server's default character set for processing within Adaptive Server. Assuming the Adaptive Server default character set is "iso_1," consider the command:

alter login loginName with password *oldPasswd* modify password *newPasswd*

The password parameters are varchar, and are expressed as a quoted string and stored with "iso_1" encoding before encryption. If the Adaptive Server default character set changes later, the encrypted password remains an encrypted string of characters encoded with the original default character set. This may result in authentication failure due to mismatched character mapping. Although changing the default character set is a rare occurrence, it becomes more important when migration occurs between platforms.

Adaptive Server converts the clear text password to canonical form before encryption so that the password can be used across platforms, chip architectures, and character sets.

To use canoncial form for storage in syslogins:

1. Convert the clear text password string to UTF-16.
2. Convert the UTF-16 string to network byte order.
3. Append a small buffer (the salt) with random bytes to the password.
4. Apply the SHA-256 hash algorithm.
5. Store digest, salt, and version in the password column.

At authentication time:

1. Convert the clear text password string to UTF-16.

2 Convert the UTF-16 string to network byte order.

3 Append the salt from the password column in syslogins to the password.

4 Apply the hash algorithm.

5 Compare results with password column in syslogins, if they match then authentication is successful.

Upgrade and downgrade behavior

This section contains information about upgrading and downgrading Adaptive Server between versions.

Note Review this section if you are upgrading to Adaptive Server version 15.7 or later from a version 15.0.

Login password downgrade

To ease the transition to the on-disk encryption algorithm when migrating from versions earlier than 15.0.2, Adaptive Server includes the password policy allow password downgrade. After an upgrade from versions earlier than 15.0.2, the policy has a value of 1 to indicate that passwords are stored in both the Sybase proprietary algorithm used in earlier versions and the SHA-256 algorithm used in Adaptive Server 15.0.2 and later.

As long as passwords are stored in both old and new forms, you can downgrade Adaptive Server to Adaptive Server 15.0 without resetting user passwords. When the policy allow password downgrade is set to 0, passwords are stored only in SHA-256 form, which is incompatible with older versions. When downgrading to previous releases, only passwords stored in SHA-256 are reset to random passwords and stored in the old form compatible with older versions.

To end the period when password downgrade is allowed, execute:

```
sp_passwordpolicy 'set', 'allow password downgrade',
'0'
```

Before executing this command, examine login accounts with sp_displaylogin to determine if the login account has been used, and whether the password is stored in SHA-256 encoding. If is not, the account is automatically locked and reset with a generated password. To use the account again, you must unlock the account and give the user a newly generated password.

You may want to save the output from this command because it can contain information about locked login accounts and generated passwords for those accounts.

When the password downgrade period ends:

- The datetime when the password downgrade period ended is recorded in master.dbo.sysattributes.
- The value of each password column in syslogins is rewritten to use only the new password on-disk structure.
- The logins that have not transitioned to the new algorithm have the password reset to a new server-generated password in SHA-256 format, and the login is locked. The generated password is displayed only to the administrator executing the sp_passwordpolicy procedure above. The lock reason is set to 3 ("Login or role not transitioned to SHA-256").

After the sp_passwordpolicy procedure completes:

- Login authentication uses only SHA-256.
- Only the new password on-disk structure for the password column is used.
- Attempts to use the locked logins fail authentication. To use the locked logins, you must unlock the login with sp_locklogin and the user must use the password generated by sp_passwordpolicy. Alternatively, you may prefer to assign a new password instead of the generated password for locked login accounts.

Example 1

This example prepares an upgraded server to use only SHA-256. Examine login accounts to determine which encryption is used by the account using sp_displaylogin.

```
1> sp_displaylogin login993
2> go
Suid: 70
Loginame: login933
Fullname:
Default Database: master
Default Language:
Auto Login Script:
Configured Authorization:
```

```
Locked: NO
Date of Last Password Change: Apr 20 2007 2:55PM
Password expiration interval: 0
Password expired: NO
Minimum password length: 0
Maximum failed logins: 3
Current failed login attempts:
Authenticate with: ANY
Login Password Encryption: SYB-PROP
Last login date:
(return status = 0)
```

The value SYB-PROP from the line Login Password Encryption: SYB-PROP indicates that only the Sybase-proprietary encryption is used for this account. This login has not been used before the upgrade to Adaptive Server version 15.0.2 and later, and will be locked, and its password reset if sp_passwordpolicy 'set', 'allow password downgrade', ‘0’ is executed.

After the first login to the account after upgrading to Adaptive Server 15.0.2, the line changes to show that both old and new encryption is used:

```
Login Password Encryption: SYB-PROP,SHA-256
```

This is the desired state for all active login accounts, so that executing sp_passwordpolicy 'set', 'allow password downgrade', ‘0’ does not lock and reset the password for accounts.

After you execute sp_passwordpolicy 'set', 'allow password downgrade', ‘0’, only SHA-256 encryption is used, and you see:

```
Login Password Encryption: SHA-256
```

Login accounts that show this value are now using the stronger, on-disk encryption algorithm.

When all passwords have been changed to use the new algorithm, reexecuting sp_passwordpolicy shows no accounts reset or locked:

```
1> sp_passwordpolicy 'set', 'allow password downgrade', '0'
2> go

Old password encryption algorithm usage eliminated from 0 login accounts,
changes are committed.
(return status = 0)
```

Example 2

In this example, 990 out of 1000 login accounts have transitioned to the SHA-256 algorithm, but 10 accounts are still using SYB-PROP algorithm:

```
1> sp_passwordpolicy 'set', 'allow password downgrade', '0'
2> go
```

```
Old password encryption algorithm found for login name login1000, suid 3,
ver1 =5, ver2 = 0, resetting password to EcJxKmMvOrDsC4
Old password encryption algorithm found for login name login999, suid 4,
ver1 =5, ver2 = 0, resetting password to MdZcUaFpXkFtM1
Old password encryption algorithm found for login name login998, suid 5,
ver1 =5, ver2 = 0, resetting password to ZePiZdSeMqBdE6
Old password encryption algorithm found for login name login997, suid 6,
ver1 =5, ver2 = 0, resetting password to IfWpXvGlBgDgW7
Old password encryption algorithm found for login name login996, suid 7,
ver1 =5, ver2 = 0, resetting password to JhDjYnGcXwObI8
Old password encryption algorithm found for login name login995, suid 8,
ver1 =5, ver2 = 0, resetting password to QaXlRuJlCrFaE6
Old password encryption algorithm found for login name login994, suid 9,
ver1 =5, ver2 = 0, resetting password to HlHcZdRrYcKyB2
Old password encryption algorithm found for login name login993, suid 10,
ver1 =5, ver2 = 0, resetting password to UvMrXoVqKmZvU6
Old password encryption algorithm found for login name login992, suid 11,
ver1 =5, ver2 = 0, resetting password to IxIwZqHxEePbX5
Old password encryption algorithm found for login name login991, suid 12,
ver1 =5, ver2 = 0, resetting password to HxYrPyQbLzPmJ3
Old password encryption algorithm usage eliminated from 10 login accounts,
changes are committed.
(return status = 1)
```

Note The login name, suid, and generated password appear to the administrator executing the procedure. The output of the command shows all 10 accounts that have not transitioned are reset (and locked).

Behavior changes on upgraded *master* database

When you upgrade the master database, Adaptive Server maintains encrypted passwords in syslogins catalogs using algorithms from the earlier- and the upgaded version of Adaptive Server in the password column.

Users can call sp_displaylogin to determine which “Login password encryption” a login uses.

On first authentication of a login after an upgrade:

- The user authenticates using the contents of the password column and the old algorithm.
- Adaptive Server updates the password column with the old encryption algorithm followed by the new encryption algorithm.

On subsequent authentication of a login after upgrade, before "allow password downgrade" is set to 0, the user authenticates using the new algorithm.

Behavior changes in a new *master* database

In a new Adaptive Server master database, or in an upgraded master database after allow password downgrade is set to 0, the server maintains encrypted passwords in syslogins using only the new algorithm in the password column. Only the SHA-256 algorithm authenticates the connection requests and stores the password on disk.

Issue sp_passwordpolicy to determine if a server was upgraded (for example, from version 15.0 to 15.0.2) and maintains passwords using algorithms from the pre- and post-upgraded server, or if the server is newly installed and includes a master database that uses the most recent algorithm (from the 15.0.2 version):

```
sp_passwordpolicy 'list', 'allow password downgrade'
```

Retaining password encryption after upgrading then downgrading

If you upgrade to an Adaptive Server 15.0.2 or later, then downgrade to an earlier version, use sp_downgrade to retain and use the password encryption functionality from the 15.0.2 and later server. By default, Adaptive Server lets you downgrade passwords after an upgrade, until you end the password downgrade period.

Note Running sp_downgrade, shutting down the server, then restarting the same version of Adaptive Server from which you downgraded removes the changes made by sp_downgrade. You must re-run sp_downgrade to redo the changes. See the *Installation Guide* for information about running sp_downgrade.

Adding space before you upgrade

Adaptive Server requires additional space in the master database, and transaction log. Use alter database to add additional space to the master database, and transaction log.

Encryption algorithms and password policies:

- Increase the space required for syslogins by about 30%.
- Increase the maximum row length by 135 bytes per login account.

- Decrease the ratio of rows per page from about 16 rows per 2K page to 12 rows per 2K page between Adaptive Server versions 15.0.1 and 15.0.2. There is a period of time during the downgrade when the value for allow password downgrade is 1 (when both old and new password encryption algorithms are used); the ratio further decreases to about 10 rows per 2K page.

  For example, if Adaptive Server 15.0.1 has 1,000 login accounts, and the data fits into 59 pages, the same number of login accounts may require approximately 19 additional pages in Adaptive Server 15.0.2 on a new master database, or 33 additional pages if you upgraded from 15.0.1 (with allow password downgrade set to 1).

The transaction log requires additional space for the updated password column. When users first log in, Adaptive Server requires about 829 2K pages per 1,000 logins, and about 343 pages per 1,000 logins for password changes users make during the upgrade and downgrade. To ensure there is sufficient log space, verify that there is approximately one 2K page of free log space per login before starting the password upgrade or downgrade, and when users first login to Adaptive Server version 15.0.2 and later.

Downgrading

Adaptive Server supports downgrading from version 15.0.2 or later to version 15.0 or 15.0.1. If you are downgrading to an earlier version of Adaptive Server, you may need to perform additional actions.

If allow password downgrade is 0 or NULL, or if a password has been stored in syslogins with only the SHA-256 algorithm, use sp_displaylogin on login accounts to determine which algorithm is used, or sp_downgrade "prepare" to determine which accounts are reset.

The prepare option reports whether the server is ready to be downgraded. If the prepare option fails, it reports errors that must be fixed. If a downgrade is performed on the server before the errors are fixed, the downgrade fails. For login passwords, prepare reports which passwords are reset during the downgrade.

Run sp_downgrade "prepare" to verify whether you should run sp_downgrade:

```
sp_downgrade 'prepare','15.0.1',1
Checking databases for downgrade readiness.

There are no errors which involve encrypted columns.

Allow password downgrade is set to 0. Login passwords
```

```
may be reset, if old encryption version of password is
not present.

Warning: New password encryption algorithm found for
login name user103, suid 103.

Password will be reset during the downgrade phase.

sp_downgrade 'prepare' completed.
(return status = 0)
```

```
drop login probe
```

If the login has user entries in databases, from the master database, drop users from databases, and then drop the login:

```
use master
sp_dropuser 'probe'
```

The probe login is re-created when you run installmaster on the downgraded server.

Before executing sp_downgrade, Sybase recommends that you drop statistics for syslogins, and syssrvroles. Doing this avoids invalid column information, such as the length of password column, in sysstatistics from being recorded during the downgrade.

To drop statistics for syslogins, and syssrvroles, enter:

```
delete statistics master..syslogins
delete statistics master..syssrvroles
```

In this example, the execution of sp_downgrade locks, and resets the login password for user103. The random password generated by Adaptive Server is shown only to the client who executes sp_downgrade. The administrator can redirect this output to a file so that these passwords are retained, or the administrator can manually reset them once the downgrade is complete, and the server is restarted.

```
sp_downgrade 'downgrade','15.0.1',1
```

```
Checking databases for downgrade readiness.
There are no errors which involve encrypted columns.

Allow password downgrade is set to 0. Login passwords may be reset, if old
encryption version of password is not present.
Warning: New password encryption algorithm found for login name user103, suid
103 .
Password is reset during the downgrade phase.
```

```
Executing downgrade step 1 [sp_passwordpolicy 'downgrade'] for :
- Database: master (dbid: 1)

New password encryption algorithm found for login name user103, suid 103.
Resetting password to 'ZdSuFpNkBxAbW9'.

Total number of passwords reset during downgrade = 1

[ ... output from other downgrade steps ..]
(return status = 0)
```

Additional messages appear in the error log to identify steps that occurred during sp_downgrade:

```
00:00000:00006:2007/05/21 05:34:07.81 server  Preparing ASE downgrade from 1502 to 1501.
00:00000:00006:2007/05/21 05:35:59.09 server  Preparing ASE downgrade from 1502 to 1501.
00:00000:00006:2007/05/21 05:35:59.19 server  Starting downgrading ASE.
00:00000:00006:2007/05/21 05:35:59.20 server  Downgrade : Downgrading login passwords.
00:00000:00006:2007/05/21 05:35:59.22 server  Downgrade : Starting password downgrade.
00:00000:00006:2007/05/21 05:35:59.23 server  Downgrade : Removed sysattributes rows.
00:00000:00006:2007/05/21 05:35:59.23 server  Downgrade : Updated 1 passwords.
00:00000:00006:2007/05/21 05:35:59.24 server  Downgrade : Removed columns in syslogins -
lastlogindate, crdate, locksuid, lockreason, lockdate are removed.
00:00000:00006:2007/05/21 05:35:59.26 server  Downgrade : Truncated password lengths.
00:00000:00006:2007/05/21 05:35:59.28 server  Downgrade : Successfully completed password
downgrade.
00:00000:00006:2007/05/21 05:35:59.28 server  Downgrade : Marking stored procedures to
be recreated from text.
00:00000:00006:2007/05/21 05:36:03.69 server  Downgrade : Dropping Sysoptions system
table.
00:00000:00006:2007/05/21 05:36:03.81 server  Downgrade : Setting master database minor
upgrade version.
00:00000:00006:2007/05/21 05:36:03.83 server  Downgrade : Setting user databases minor
upgrade version.
00:00000:00006:2007/05/21 05:36:03.90 server  ASE downgrade completed.
```

sp_downgrade makes catalog changes, and modifies password data. The server must be in single user mode to successfully execute sp_downgrade. To start the server in single user mode, and to allow only the System Administrator to log in, use the -m command line option to start the server.

After running sp_downgrade, shut down the 15.0.2 server to avoid new logins or other actions that may modify data or system catalogs. If you restart Adaptive Server at version 15.0.2 after running sp_downgrade, the earlier version shuts down and you are again upgraded to the version 15.0.2 or later level.

Expiring passwords when *allow password downgrade* is set to 0

Expire passwords in syslogins at the end of the password downgrade period.

To configure login passwords to expire, use:

sp_passwordpolicy "expire login passwords"[, "[*loginame* | *wildcard*]"

To configure role passwords to expire, use:

sp_passwordpolicy "expire role passwords"[, "[*rolename* | *wildcard*]"

To configure stale login passwords to expire, use:

sp_passwordpolicy "expire stale login passwords", "*datetime*"

To configure stale role passwords to expire, use:

sp_passwordpolicy "expire stale role passwords", "*datetime*"

Passwords that are not changed since the date you set in the *datetime* parameter of the sp_passwordpolicy "expire stale login passwords," expire when you execute the command. Users are automatically required to change their passwords after the password downgrade period ends.

You can also lock stale logins or roles; however this requires you to reset the password manually for legitimate users to access their login account again.

Showing the current value of *allow password downgrade*

To obtain the current value of allow password downgrade enter:

sp_passwordpolicy ‘list’, ‘allow password downgrade’

The result set includes the current value, and a message indicating its meaning.

If you have upgraded the master database, and are maintaining passwords with the old and new encodings, the result is:

```
sp_passwordpolicy 'list', 'allow password downgrade'
go

value    message
-------- -----------------------------------------------------
       1 Password downgrade is allowed.
(1 row affected)
```

For an upgraded master database that only uses new password encryption, the result is:

```
sp_passwordpolicy 'list', 'allow password downgrade'
go

value    message
```

```
-------- ------------------------------------------------------
       0 Last Password downgrade was allowed on <datetime>.
(1 row affected)
```

For a new master database on Adaptive Server 15.0.2 that only uses new password encryption, the result is:

```
sp_passwordpolicy 'list', 'allow password downgrade'
go

value    message
-------- ------------------------------------------------------
   NULL New master database.
(1 row affected)
```

Using passwords in a high-availability environment

Password security impacts configuration of high availability, the behavior of passwords in syslogins between primary, and companion servers.

High-availability configuration

The primary and companion servers must have equivalent allow password downgrade values before you configure them for high availability. The allow password downgrade quorum attribute checks whether the value of allow password downgrade is the same on both primary, and secondary servers.

If allow password downgrade on the primary server is 1, and 0 on the secondary server, then the output of sp_companion is:

```
1> sp_companion "primary_server",configure
2> go

Step: Access verified from Server:'secondary_server' to
Server:'primary_server'.
Step: Access verified from Server:'primary_server' to
Server:'secondary_server'.
Msg 18836, Level 16, State 1:
Server 'secondary_server', Procedure 'sp_companion', Line 392:
Configuration operation 'configure' can not proceed due to Quorum Advisory Check
failure. Please run 'do_advisory' command to find the incompatible attribute
and fix it.

Attribute Name        Attrib Type      Local Value   Remote Value   Advisory
--------------        -----------      -----------   ------------   --------
allow password downg  allow password             0              1          2
```

```
(1 row affected)
(return status = 1)
```

A value of 2 in the Advisory column indicates that the user cannot proceed with the cluster operation unless the values on both companions match.

sp_companion do_advisory also lists the difference in the value of allow password downgrade on both servers.

Run sp_passwordpolicy ‘allow password downgrade’ independently on both the primary, and secondary servers to synchronize the value, and to ensure both servers are in the same state.

Passwords updated after upgrade

Upon the first connection to the primary server after upgrading and configuring for high availability, the user login password synchronizes on both the primary and companion servers with the same on-disk encryption format. This avoids password reset or locking when the allow password downgrade period ends, and passwords are downgraded to an earlier version of Adaptive Server. Login passwords continue to be used without being reset or locked by sp_passwordpolicy or sp_downgrade.

After successfully setting up high-availability environment, end the allow password downgrade period separately on the primary and companion servers. Similarly, downgrade to an earlier version of Adaptive Server, execute sp_downgrade separately on the primary and companion servers.

Establishing a password and login policy

FlkAdaptive Server includes several controls for setting policies for logins, roles, and passwords for internal authentication.

In Adaptive Server, the system security officer can:

- Specify the maximum allowable number of times an invalid password can be entered for a login or role before that login or role is automatically locked
- Log in after a lost password
- Manually log and unlock logins and roles

- Display login password information
- Specify the minimum password length required server-wide, or for a specific login or role
- Check for password complexity of logins
- Enable custom password checks of logins
- Set the password expiration interval
- Consider login password character set
- Lock inactive login accounts
- Use passwords in a high availability environment

Login failure

Adaptive Server must successfully authenticate a user before he or she can access data in Adaptive Server. If the authentication attempt fails, Adaptive Server returns the following message and the network connection is terminated:

```
isql -U bob -P badpass
Msg 4002, Level 14, State 1:
Server 'ACCOUNTING'
Login failed.
CT-LIBRARY error:
ct_connect(): protocol specific layer: external error:
The attempt to connect to the server failed
```

This message is a generic login failure message that does not tell the connecting user whether the failure resulted from a bad user name or a bad password.

Although the client sees a generic message for a login failure to avoid giving information to a malicious user, the system administrator may find the reason for the failure to be important to help detect intrusion attempts and diagnose user authentication problems.

Adaptive Server provides the reason for the login failure in the `Errornumber.Severity.State` of the `Other Information` section of sysaudits.extrainfo column. Login failure audits have event number 45 and eventmod 2.

Set the sp_audit login parameter to on or fail to enable auditing for login failure:

```
sp_audit "login", "all", "all", "fail"
sp_audit "login", "all", "all", "on"
```

See "Auditing login failures."

Locking Adaptive Server login accounts and roles

To prevent a user from logging in to Adaptive Server, you can either lock or drop an Adaptive Server login account. Locking a login account maintains the suid so that it cannot be reused.

Execute sp_locklogin to lock login accounts

Audit records with audit event AUD_EVT_LOGIN_LOCKED (112) are generated under the login_locked audit option when the login account is locked because login attempts have reached a configured maximum failed login value.

Warning! Adaptive Server may reuse the server user ID (suid) of a dropped login account when the next login account is created. This occurs only when the dropped login holds the highest suid in syslogins; however, it can compromise accountability if execution of drop login is not being audited. Also, it is possible for a user with the reused suid to access database objects that were authorized for the old suid.

You cannot drop a login when:

- The user is in any database.
- The login is the last remaining user who holds the system security officer or system administrator roles.

The system security officer can lock or drop a login using sp_locklogin or drop login. If the system procedure is being logged for replication, the system security officer must be in the master database when issuing the command.

Locking and unlocking logins

A login can be locked when:

- Its password expires, or

- The maximum number of failed login attempts occur, or
- The system security officer manually locks it.

❖ **Locking and unlocking logins**

- The system security officer can use sp_locklogin to manually lock or unlock a login. For example:

  ```
  sp_locklogin "joe" , "lock"
  sp_locklogin "joe" , "unlock"
  ```

  Information about the lock status of a login is stored in the status column of syslogins.

  See sp_locklogin in *Reference Manual: Procedures*.

Locking and unlocking login accounts

Use sp_locklogin to lock and unlock accounts or to display a list of locked accounts. You must be a system security officer to use sp_locklogin.

The syntax is:

sp_locklogin [{*login_name* }, { "lock" | "unlock" }]

where:

- *login_name* is the name of the account to be locked or unlocked. The login name must be an existing valid account.
- all indicates to lock or unlock all login accounts on an Adaptive Server, except those with sa_role.
- lock | unlock specifies whether the account is to be locked or unlocked.

To display a list of all locked logins, use sp_locklogin with no parameters.

You can lock an account that is currently logged in, and the user is not locked out of the account until he or she logs out. You can lock the account of a database owner, and a locked account can own objects in databases. In addition, you can use sp_changedbowner to specify a locked account as the owner of a database.

Adaptive Server ensures that there is always at least one unlocked system security officer's account and one unlocked system administrator's account.

Using *syslogins* to track if an account is locked

syslogins includes the lastlogindate, crdate, locksuid, lockreason, and lockdate columns to support the last login, and locking inactive accounts, letting an account owner or administrator know if an account is locked, when it was locked, who locked it, and the reason why it was locked.

At login creation, the crdate column is set to the current time.

If the enable last login updates password policy option is set to 1, the lastlogindate column is set to the datetime of the login, and the previous value of the column is stored in the process status structure of the login session. The update to syslogins and the process status structure can occur at each login to Adaptive Server. The default value for enable last login updates a new master database or an upgraded database is 1. To disable this option execute the procedure using administrator privileges:

```
sp_passwordpolicy 'set', 'enable last login updates',
'0'
```

@@lastlogindate is specific to each user login session, and can be used by that session to determine the date and time of the previous login to the account. If the account has not been previously used or if enable last login updates is 0, the value of *@@lastlogindate* is NULL.

The transaction log does not log updates to syslogins..lastlogindate.

Administrators with sso_role can lock login accounts that are inactive for a given number of days, using:

sp_locklogin 'lock', [@except], '*number of inactive days*'

This command has no effect if enable last login updates is set to 0 or the value of the lastlogindate column is NULL. The range of values for *number of inactive days* is 1 – 32767 (days).

The lockreason column specifies the reason a login was locked. The value of the lockdate column is set to the current datetime.

When an account is unlocked, columns lockreason, lockdate, and locksuid are reset to NULL.

The lockdate, locksuid, and lockreason columns are set internally by Adaptive Server. Table 3-3 provides lockreason values and descriptions, and the value of locksuid.

Table 3-3: The reasons and values of locksuid

Values for lockreason	Values for locksuid	Description of lockreason account
NULL	NULL	Account has not been locked.
0	suid of caller of sp_locklogin	Account locked by locksuid by manually executing sp_locklogin.
1	suid of caller of sp_locklogin	Account locked due to account inactivity, locksuid has manually executed sp_locklogin 'all', 'lock', 'ndays'.
2	suid of attempted login	Account locked by Adaptive Server due to failed login attempts reaching maximum failed logins.
3	suid of caller of sp_passwordpolicy set, "allow password downgrade", 0	Account locked by locksuid as the password downgrade period has ended, and login or role has not transitioned to SHA-256.
4	NULL	Account locked due to account inactivity.

Locking and unlocking roles

Accounting information such as when the role was locked, why it was locked, and who locked is stored in syssrvroles, and can be useful for role locking accounting.

There are several reasons roles may be locked:

- Entering the wrong role password a specified number of times. 'max failed_logins' option can be associated with roles during their creation or alteration. It specifies the number of failed role activation attempts after which a role is locked.
- Manually locking the role using alter role:

  ```
  alter role rolename lock
  ```

Adaptive Server includes these columns in syssrvroles for lock information:

- lockdate – indicates when the role was locked.
- locksuid – indicates who locked the role.
- lockreason – gives a reason why it was locked. This is in the form of codes:

Values for lockreason	Value for locksuid	Description of lockreason of role
NULL	NULL	Role is not locked

Values for lockreason	Value for locksuid	Description of lockreason of role
1	suid of caller of alter role	Role locked by suid by manually executing alter role rolename lock
2	suid of user whose last attempted role activation led to the role getting locked	Role locked by Adaptive Server due to failed role activation attempts reading max failed logins.

❖ **Locking and unlocking roles**

- The system security officer can use alter role to manually lock or unlock a role. For example:

  ```
  alter role physician_role lock
  alter role physician_role unlock
  ```

  Information about the lock status of a role is stored in the status column of syssrvroles.

  See alter role in *Reference Manual: Commands*.

Note In high-availability environments, these syssrvrole columns are updated on both the primary and secondary servers.

Locking logins that own thresholds

This section discusses thresholds and how they are affected by locked user logins.

- As a security measure, threshold stored procedures are executed using the account name and roles of the login that created the procedure.
  - You cannot drop the login of a user who owns a threshold.
  - If you lock the login of a user who owns a threshold, the user cannot execute the stored procedure.
- The last-chance threshold, and thresholds created by the “sa” login are not affected by sp_locklogin. If you lock the “sa” login, the last chance threshold and thresholds created or modified by the “sa” user still fire.

Managing login profiles

System security officers can define, alter, and drop login profiles.

Table 3-1 summarizes the system procedures and commands used to create and manage login profiles.

Table 3-4: Managing login profiles in Adaptive Server

Task	Required role	Command or procedure	Database
Create login profiles	System security officer	create login profile	Master database
Alter login profiles	System security officer	alter login profile	Master database
Drop login profiles	System security officer	drop login profile	Master database
Return login profile ID	System security officer	lprofile_id	Any database
Return login profile name	System security officer	lprofile_name	Any database
Display the name login profiles	System security officer	sp_displaylogin	Any database
Displays information about login profiles	System security officer	sp_securityprofile	Any database

Login profile attributes

Table 3-5 summarizes the attributes of login profiles. Login profile attributes are stored in syslogins, sysloginroles and master.dbo.sysattributes.

Table 3-5: Login Profile Attributes

Attribute	Description
default database	Default database in Adaptive Server.
default language	Default language.
login script	Valid stored procedure. Stored procedures used as a login script through create login, alter login, create login profile, and alter login profile, is restricted to 120 characters.
auto activated roles	Previously granted user-defined roles that are not password-protected that must be automatically activated on login. An error is generated if the role specified is not granted to the login. By default, user-defined roles are not automatically activated on login.
authenticate with	Specifies the mechanism used for authenticating the login account. If authenticate with *authentication mechanism* is not specified, the value ANY will be used for the login account.
track lastlogin	Enables last login updates.
stale period	Indicates the duration a login account is allowed to remain inactive before it is locked due to inactivity.
profile id	Specifies a database in Adaptive Server.

Applying login profile and password policy attributes

The attributes of a large number of login accounts can be managed by defining a login profile as the default for all login accounts, a subset of login accounts, or individual login accounts.

The attributes of login profiles are associated with login accounts using the following precedence:

1. Attribute values from a login profile bound to the login
2. Attribute values from a default login profile
3. Values which have been specified using sp_passwordpolicy under the following circumstances:
   - A default login profile does not exit
   - A login profile has not been defined and bound to the account
   - The login profile is set to be ignored (the parameter with login profile ignore is specified for the command create login)
4. The default value for the attribute

Creating a login profile

The following steps describe creating a login profile and login account for a particular server and manage permissions for the users.

1. A system security officer creates a login profile for login accounts.
2. A system security officer creates a login account for a new user and associates the login profile to the new login account.
3. A system administrator or database owner adds a user to database or assigns a user to a group.
4. A system security officer grants specific roles to the user or to a login profile.
5. A system administrator, database owner, or object owner grants the user or group specific permissions on specific commands and database objects.

This example creates a login profile mgr_lp:

```
create login profile mgr_lp
```

See create login profile in the *Reference Manual: Commands*.

Creating a default login profile

The following example creates a default login profile named emp_lp. If another login profile is currently configured as the default login profile, the default property is removed and applied to emp_lp:

```
create login profile emp_lp as default
```

See create login profile in the *Reference Manual: Commands*.

Associating a login profile with a login account

If a login profile is not specified when creating a login account, the default login profile is associated with the new account. If a default login does not exist, Adaptive Server applies password policy attributes specified by sp_passwordpolicy or default attributes. See Applying login profile and password policy attributes for information about the order in which attributes are applied.

The following example creates the login account omar_khayyam with password rubaiyat and associates the account with the login profile emp_lp:

```
create login omar_khayyam with password rubaiyat login
      profile emp_lp
```

The following example modifies the login account omar_khayyam and associates the account with the login profile staff_lp:

```
alter login omar_khayyam modify login profile staff_lp
```

Ignoring a login profile

The ignore login profile clause is used to disable login profiles associated directly or through a default login profile. Adaptive Server follows precedence rules for applying the corresponding attributes of the login account. For more information, see Applying login profile and password policy attributes.

The following example creates a login account and specifies to ignore any login profiles.

```
create login maryb with password itsAsecur8 login
profile ignore
```

Transfer existing login account values to a new login profile

The following example shows how to transfer existing login account values to a new login profile. The login profile sa_lp is created with default database, default language, and authenticate with attribute values set to the same values of the login account ravi.

```
create login profile sa_lp with attributes from ravi
```

Manual replication of login profiles

The profile ID is an attribute that specifies an ID for a new login profile and is used for manual replication of login profiles across Adaptive Server.

For example, if the profile emp_lp with a profile ID of 25 is to be created on the replicate master, execute the followingt command:

```
create login profile emp_lp with profile id 25
```

Granting roles to login profiles

The following example creates the login profile def_lp and grants the role access_role to the login profile.

```
create login profile def_lp
grant role access_role to def_lp
```

Any login bound to def_lp will be implicitly granted access_role. The system security officer can specify a role granted to a login profile to behave as a default role for the bound logins, that is, the role is automatically activated in the user's session upon login.

For information about adding or dropping auto activated roles, see "Adding or dropping auto-activated roles" on page 65.

Invoking a login script

A login script can be specified to be invoked on login through a login profile. If a global login trigger is specified through sp_logintrigger, the login script is invoked after the global login trigger.

```
create login profile with login script 'empNew.script'
```

- A login script can be qualified by specifying the database where it resides and the owner name. When not qualified with a database name, the default database takes precedence over the master database.
- If the specified login script is not qualified with an owner name, the owner of the login trigger, which is the current login, takes precedence over the database owner where the login trigger resides.
- Stored procedures used as a login script through create login, alter login, create login profile, and alter login profile, is restricted to 120 characters.

For more information see, "Using login triggers" on page 232.

Displaying login profile information

This section discusses how to display information about login profiles.

Displaying the login profile name

To display the login profile name of a specified login profile ID or login suid, use:

lprofile_name([{*login profile id* | *login suid*}])

System security officer role is required to view the profile name of the specified login ID if it is not the current user's login ID.

The following displays the login profile name of the specified login profile ID:

```
select lprofile_name(3)
-------------
   intern_lr
```

If no parameter is specified the login profile name of the current user is returned. If a login profile is not associated with the specified login account, then the login profile name of the default login profile is returned. The login profile ignore parameter must not be set.

The login profile name can also be displayed using sp_displaylogin. If a login profile is not directly associated with the login account and a default login profile exist, the name of the default login profile is displayed.

Displaying the login profile ID

To display the login profile ID of a specified login profile name or login name, use:

*lprofile*_id([{*login profile name* | *login name*}])

System security officer role is required to view the profile ID of the specified login name if it is not the current user's login name.

The following displays the login profile name of the specified login profile ID:

```
select lprofile_id('intern_lr')
-------------
   3
```

If a login profile is not associated with the specified login account, then the profile ID of the default login profile is returned. The login profile ignore parameter must not be set.

Displaying login profile binding information

Use sp_securityprofile to display the login profile attributes associated with a login account.

Note A non-privileged login account can only display the attributes of a login profile that it is directly associated with, or the attributes of the default login profile. System security officer role is required to see attributes and bindings of all login profiles.

For more syntax information, see sp_securityprofile, in *Reference Manual: System Procedures*.

Modifying login profiles

The alter login profile command can be used to add, drop or change attributes of a login profile and their corresponding values. If the attributes have not been specified, they will be added to the login profile. See "Login Profile Attributes" on page 59 for a list of login profile attributes.

The following example removes the login script attribute from the login profile mgr_lp. If a login script is specified for the default login profile, it will be invoked on login, otherwise no login script will be invoked.

```
alter login profile mgr_lp drop login script
```

See alter login profile in the *Reference Manual: Commands* for complete syntax.

Adding or dropping auto-activated roles

Previously granted user defined roles that are not password protected can be automatically activated on login.

The following modifies the login profile mgr_lp and automatically activates the roles mgr_role and eng_role when users associated with mgr_lp log in.

```
alter login profile mgr_lp add auto activated roles
      mgr_role, eng_role
```

The auto activated roles status of user defined roles granted to login profiles is indicated in the sysloginroles.status column. A value of ‘1’ indicates the granted role must be automatically activated on login. Revoking a role will remove its corresponding row in sysloginroles and the role will not be automatically activated on login. Adaptive Server automatically activates roles granted to a user's login profile as follows:

1 If a default login profile is associated with the account, any auto activated roles specified in the default login profile are applied.

2 If both a login profile that is directly associated with an account and a default login profile exist, only the auto activated roles specified in a login profile associated directly with the account are applied.

Changing a login profile to be the default login profile

The as [not] default clause is used to assign or remove a login profile as the default login profile.

The following statement alters the login profile named emp_lp as the default login profile.

```
alter login profile emp_lp as default
```

The following statement removes the login profile named emp_lp as the default login profile.

```
alter login profile userGroup_lp as not default
```

Dropping a login profile

The command drop login profile removes the login profile if it is not bound to a login account. Use drop login profile with override to forcefully remove a login profile that is bound to a login account. If the login profile is bound with a login account, the login account will be bound to the default login account, if one exist. If the login profile ignore clause has been specified, the clause is removed and the default login profile, if it exists, will be associated with the login account.

The following example forcefully removes the login profile eng_lp even if it is bound to one or more login accounts.

```
drop login profile eng_lp with override
```

Adding users to databases

The database owner or a system administrator can use sp_adduser to add a user to a specific database. The user must already have an Adaptive Server login. The syntax is:

sp_adduser *loginame* [, *name_in_db* [, *grpname*]]

Where:

- *loginame* – is the login name of an existing user.
- *name_in_db* – specifies a name that is different from the login name by which the user is to be known inside the database.

  Use *name_in_db* to accommodate users' preferences. For example, if there are five Adaptive Server users named Mary, each must have a different login name. Mary Doe might log in as "maryd", Mary Jones as "maryj", and so on. However, if these users do not use the same databases, each might prefer to be known simply as "mary" inside a particular database.

If no *name_in_db* parameter is given, the name inside the database is the same as loginame.

Note This capability is different from the alias mechanism described in "Using aliases in databases" on page 72, which maps the identity and permissions of one user to another.

- *grpname* – is the name of an existing group in the database. If you do not specify a group name, the user is made a member of the default group "public." Users remain in "public" even if they are a member of another group. See "Changing a user's group membership" on page 71.

sp_adduser adds a row to the sysusers system table in the current database. When a user has an entry in the sysusers table of a database, he or she:

- Can issue use *database_name* to access that database
- Will use that database by default, if the default database parameter was issued as part of create login
- Can use alter login to make that database the default

This example shows how a database owner can give access permission to "maryh" of the engineering group "eng," which already exists:

```
sp_adduser maryh, mary, eng
```

This example shows how to give "maryd" access to a database, keeping her name in the database the same as her login name:

```
sp_adduser maryd
```

This example shows how to add "maryj" to the existing "eng" group, keeping her name in the database the same as her login name by using null in place of a new user name:

```
sp_adduser maryj, null, eng
```

Users who have access to a database still need permissions to read data, modify data, and use certain commands. These permissions are granted with the grant and revoke commands, discussed in Chapter 6, "Managing User Permissions."

Adding a "guest" user to a database

Creating a user named "guest" in a database enables any user with an Adaptive Server account to access the database as a **guest** user. If a user who has not been added to the database as a user or an aliased user issues the use *database_name* command, Adaptive Server looks for a guest user. If there is one, the user is allowed to access the database, with the permissions of the guest user.

The database owner can use sp_adduser to add a guest entry to the sysusers table of the database:

```
sp_adduser guest
```

The guest user can be removed with sp_dropuser, as discussed in "Dropping users" on page 82.

If you drop the guest user from the master database, server users who have not yet been added to any databases cannot log in to Adaptive Server.

Note Although more than one individual can be a guest user in a database, Adaptive Server can still use the user's server user ID, which is unique within the server, to audit each user's activity. See Chapter 8, "Auditing."

"guest" user permissions

"guest" inherits the privileges of "public." The database owner and the owners of database objects can use grant and revoke to make the privileges of "guest" either more or less restrictive than those of "public." See Chapter 6, "Managing User Permissions."

When you install Adaptive Server, master..sysusers contains a guest entry.

"guest" user in user databases

In user databases, the database owner adds a guest user that permits all Adaptive Server users to use that database, which saves the owner from having to use sp_adduser to explicitly name each user as a database user.

You can use the guest mechanism to restrict access to database objects while allowing access to the database.

For example, the owner of the titles table can grant select permission on titles to all database users except "guest" by executing:

```
grant select on titles to public
```

```
sp_adduser guest
revoke all on titles from guest
```

"guest" user in installed system databases

Adaptive Server creates the system tempdb database and user-created temporary databases with a guest user. Temporary objects and other objects created in tempdb are automatically owned by user "guest." sybsystemprocs, sybsystemdb, and sybsyntax databases automatically include the "guest" user.

"guest" user in *pubs2* and *pubs3*

The "guest" user entry in the sample databases allows new Adaptive Server users to follow the examples in the *Transact-SQL Users Guide*. The guest is given a wide range of privileges, including:

- select permission and data modification permission on all of the user tables
- execute permission on all of the procedures
- create table, create view, create rule, create default, and create procedure permissions

Adding a guest user to the server

The system security officer can use create login to enter a login name and password that visiting users are instructed to use. Typically, such users are granted restricted permissions. A default database may be assigned.

Warning! A visitor user account is not the same as the "guest" user account. All users of the visitor account have the same server user ID; therefore, you cannot audit individual activity. Each "guest" user has a unique server ID, so you can audit individual activity and maintain individual accountability. Sybase recommends that you do not set up a visitor account to be used by more than one user because you cannot maintain individual accountability.

You can use create login to add a visitor user account named "guest" to master..syslogins. This "guest" user account takes precedence over the system "guest" user account. If you add a visitor user named "guest" with sp_adduser, this impacts system databases such as sybsystemprocs and sybsystemdb, which are designed to work with system "guest" user in them.

Adding remote users

You can allow users on another Adaptive Server to execute stored procedures on your server by enabling remote access. Working with the system administrator of the remote server, you can also allow users of your server to execute **remote procedure calls** to the remote server.

To enable remote procedure calls, you must reconfigure both the local and the remote servers. See Chapter 7, "Managing Remote Servers" in *System Administration Guide, Volume I*.

Creating groups

Groups let you grant and revoke permissions to more than one user in a single statement, as well as allow you to provide a collective name to a group of users. They are especially useful if you administer an Adaptive Server installation that has a large numbers of users.

Create groups before adding users to a database, since sp_adduser can assign users to groups as well as add them to the database.

You must have the system administrator or system security officer role, or be the database owner to create a group with sp_addgroup. The syntax is:

sp_addgroup *grpname*

The group name, a required parameter, must adhere to the rules for identifiers. The system administrator, system security officer, or the database owner can use sp_changegroup to assign or reassign users to groups.

For example, to set up the Senior Engineering group, use this command while using the database to which you want to add the group:

```
sp_addgroup senioreng
```

sp_addgroup adds a row to sysusers in the current database. Therefore, each group in a database, as well as each user, has an entry in sysusers.

Changing a user's group membership

A system administrator, system security officer, or the database owner can use sp_changegroup to change a user's group affiliation. Each user can be a member of only one group other than "public," of which all users are always members.

Before you execute sp_changegroup:

- The group must exist.
- The user must have access to the current database (must be listed in sysusers).

The syntax for sp_changegroup is:

sp_changegroup *grpname*, *username*

For example, to change the user "jim" from his current group to the group "management," use:

```
sp_changegroup management, jim
```

To remove a user from a group without assigning the user to another group, you must change the group affiliation to "public":

```
sp_changegroup "public", jim
```

The name "public" must be in quotes because it is a reserved word. This command reduces Jim's group affiliation to "public" only.

When a user changes from one group to another, the user loses all permissions that he or she had as a result of belonging to the old group, but gains the permissions granted to the new group.

The assignment of users into groups can be changed at any time.

Setting up groups and adding users

The system security officer, the system administrator, or the database administrator creates a group using sp_addgroup *group_name*.

You can grant and revoke permissions at the group level. Group permissions are automatically passed to group members. Every database is created with a group named "public" to which all users automatically belong. Add a user to a group using sp_adduser and change a user's group with sp_changegroup. See "Changing a user's group membership" on page 71.

Groups are represented by an entry in the sysusers table. You cannot use the same name for creating a group and a user in the database (for example, you cannot have both a group and a user named “shirley”).

Using aliases in databases

The alias mechanism allows you to treat two or more users as the same user inside a database so that they all have the same privileges. This mechanism is often used so that more than one user can assume the role of database owner. A database owner can use the setuser command to impersonate another user in the database. You can also use the alias mechanism to set up a collective user identity.

For example, suppose that several vice presidents want to use a database with identical privileges and ownerships. If you add the login “vp” to Adaptive Server and the database and have each vice president log in as “vp,” there is no way to tell the individual users apart. Instead, alias all the vice presidents, each of whom has his or her own Adaptive Server account, to the database user name “vp.”

Note Although more than one individual can use the alias in a database, you can still maintain individual accountability by auditing the database operations performed by each user. See Chapter 8, “Auditing.”

The collective user identity from using aliases implies set-ownership for database objects. For example, if user “loginA” is aliased to `dbo` in in database `db1`, all objects created by “loginA” in `db1` are owned by `dbo`. However, Adaptive Server concretely records an object’s ownership in terms of the login name and the creator’s database user ID. See “Concrete identification” on page 185. An alias cannot be dropped from a database if he or she concretely owns objects in that database.

Note You cannot drop the alias of a login if that login created objects in the database. In most cases, use aliases only for users who do not own tables, procedures, views, or triggers.

Adding aliases

To add an alias for a user, use sp_addalias:

sp_addalias *loginame*, *name_in_db*

where:

- *loginame* – is the name of the user who wants an alias in the current database. This user must have an account in Adaptive Server but cannot be a user in the current database.
- *name_in_db* – is the name of the database user to whom the user specified by *loginame* is to be linked. The *name_in_db* must exist in sysusers in the current database.

Executing sp_addalias maps the user name specified by *loginame* to the user name specified by *name_in_db*. It does this by adding a row to the system table sysalternates.

When a user tries to use a database, Adaptive Server checks for the user's server user ID number (*suid*) in sysusers. If it is not found, Adaptive Server then checks sysalternates. If the user's *suid* is found there, and it is mapped to a database user's *suid*, the first user is treated as the second user while the first user is using the database.

For example, suppose that Mary owns a database. She wants to allow both Jane and Sarah to use the database as if they were its owner. Jane and Sarah have logins on Adaptive Server but are not authorized to use Mary's database. Mary executes the following commands:

```
sp_addalias jane, dbo
exec sp_addalias sarah, dbo
```

Warning! Users who are aliased to the database owner have all the permissions and can perform all the actions that can be performed by the database owner, with respect to the database in question. A database owner should carefully consider the implications of vesting another user with full access to a database.

Dropping aliases

Use sp_dropalias to drop the mapping of an alternate *suid* to a user ID. Doing this deletes the relevant row from sysalternates. The syntax is the following, where *loginame* is the name of the user specified by *loginame* when the name was mapped with sp_addalias:

sp_dropalias *loginame*

After a user's alias is dropped, the user no longer has access to the database.

You cannot drop an alias if the aliased login created any objects or thresholds. Before using sp_dropalias to remove an alias that has performed these actions, remove the objects or procedures. If you still need them after dropping the alias, re-create them with a different owner.

Getting information about aliases

To display information about aliases, use sp_helpuser. For example, to find the aliases for "dbo," execute:

```
sp_helpuser dbo
```

```
Users_name     ID_in_db    Group_name   Login_name
----------     --------    ----------   ----------
dbo            1           public       sa
```

```
(1 row affected)
```

```
Users aliased to user.
Login_name
----------------------
andy
christa
howard
linda
```

Getting information about users

Table 3-6 lists procedures you can use to obtain information about users, groups, and current Adaptive Server usage.

Table 3-6: Reporting information about Adaptive Server users and groups

Task	Procedure
Report current Adaptive Server users and processes	sp_who
Display information about login accounts	sp_displaylogin
Report users and aliases in a database	sp_helpuser
Report groups within a database	sp_helpgroup

Reporting on users and processes

Use sp_who to report information about current users and processes on Adaptive Server:

sp_who [*loginame* | "*spid*"]

where:

- *loginame* – is the user's Adaptive Server login name. If you provide a login name, sp_who reports information about processes being run by that user.
- *spid* – is the number of a specific process.

For each process run, sp_who reports the security-relevant information for the server process ID, its status, the login name of the process user, the real login name (if *login_name* is an alias), the name of the host computer, the server process ID of a process that is blocking this one (if any), the name of the database, and the command being run.

If you do not provide a login name or *spid*, sp_who reports on processes being run by all users.

The following example shows the security-relevant results from executing sp_who without a parameter:

```
fid spid  status      loginame   origname   hostname        blk_spid  dbname
   tempdbname  cmd               block_xloid    threadpool
--- ----  ---------   ---------  ---------  ---------------   --------  -----------
   ----------- ---------------- -----------    -----------------
  0    1    running         sa         sa          sunbird        0        pubs2
       tempdb  SELECT                     0     syb_default_pool
  0    2   sleeping       NULL       NULL                          0       master
       tempdb  NETWORK HANDLER            0     syb_default_pool
  0    3   sleeping       NULL       NULL                          0       master
       tempdb  MIRROR HANDLER             0     syb_default_pool
  0    4   sleeping       NULL       NULL                          0       master
       tempdb  AUDIT PROCESS              0     syb_default_pool
  0    5   sleeping       NULL       NULL                          0       master
```

```
tempdb  CHECKPOINT SLEEP          0     syb_default_pool
```

sp_who reports NULL for the *loginame* for all system processes.

Getting information about login accounts

Use sp_displaylogin to display information about a specified login account—or login names matching a wild-card pattern—including any roles granted, where *loginame* (or the wildcard matching pattern) is the user login name pattern about which you want information:

sp_displaylogin [*loginame* | *wildcard*]

If you are not a system security officer or system administrator, you can display information only about your own account. If you are a system security officer or system administrator, you can use the *loginame* | *wildcard* parameter to access information about any account.

sp_displaylogin displays your server user ID, login name, full name, any roles that have been granted to you, date of last password change, default database, default language, whether your account is locked, any auto-login script, password expiration interval, whether password has expired, the login password encryption version used, and the authentication mechanism specified for the login.

sp_displaylogin displays all roles that have been granted to you, so even if you have made a role inactive with the set command, that role appears. For example, this displays the roles for the sa:

```
sp_displaylogin 'sa'
```

```
Suid: 121
Loginame: mylogin
Fullname:
Default Database: master
Default Language:
Auto Login Script:
Configured Authorization:
        sa_role (default ON)
        sso_role (default ON)
        oper_role (default ON)
        sybase_ts_role (default ON)
Locked: NO
Date of Last Password Change: Aug 10 2006 11:17AM
Password expiration interval: 0
Password expired: NO
```

```
Minimum password length: 6
Maximum failed logins: 0
Current failed login attempts:
Authenticate with: NONE
Login password encryption: SYB-PROP, SHA-256
Last login date : Aug 17 2006 5:55PM
(return status = 0)
```

Getting information about database users

Use sp_helpuser to report information about authorized users of the current database, where *name_in_db* is the user's name in the current database:

sp_helpuser [*name_in_db*]

If you give a user's name, sp_helpuser reports information about that user. If you do not give a name, it reports information about all users.

The following example shows the results of executing sp_helpuser without a parameter in the database pubs2:

```
sp_helpuser
Users_name  ID_in_db  Group_name Login_name
----------  --------  ---------- ----------
dbo         1         public     sa
marcy       4         public     marcy
sandy       3         public     sandy
judy        5         public     judy
linda       6         public     linda
anne        2         public     anne
jim         7         senioreng  jim
```

Finding user names and IDs

To find a user's server user ID or login name, use suser_id and suser_name.

Table 3-7: System functions suser_id and suser_name

To find	Use	With the argument
Server user ID	suser_id	(["server_user_name"])
Server user name (login name)	suser_name	([server_user_ID])

The arguments for these system functions are optional. If you do not provide one, Adaptive Server displays information about the current user.

This example shows how to find the server user ID for the user "sandy:"

```
select suser_id("sandy")

------
     3
```

This example shows how a system administrator whose login name is "mary" issues the commands without arguments:

```
select suser_name(), suser_id()
------------------------------ ------
mary                                4
```

To find a user's ID number or name inside a database, use user_id and user_name.

Table 3-8: System functions user_id and user_name

To find	Use	With the argument
User ID	user_id	(["db_user_name"])
User name	user_name	([db_user_ID])

The arguments for these functions are optional. If you do not provide one, Adaptive Server displays information about the current user. For example:

```
select user_name(10)
----------------------------------------------------
NULL
(1 row affected)

select user_name( )
----------------------------------------------------
dbo
(1 row affected)

select user_id("joe")
----------------------------------------------------
NULL
(1 row affected)
```

Changing user information

Table 3-9 lists the system procedures you use to change passwords, default database, default language, full name, or group assignment.

Table 3-9: Commands or system procedures for changing user information f

Task	Required role	System procedure	Master database for: alter/create/drop login/login profile commands
Change your password	User	alter login	Any database
Change another user's password	System security officer	alter login	Any database
Change authentication mechanism	System security officer	alter login alter login profile	Any database
Change full name	System security officer	alter login	Any database
Change your own full name	User	alter login	Any database
Change default language or default database	System security officer	alter login profile alter login	Any database
Change the group assignment of a user	System administrator, database owner, or system security officer	sp_changegroup	User database
Changing a login profile	System security officer	alter login profile	Any database
Configuring a login trigger	System security officer	alter login profile	Any database

Changing passwords

All users can change their passwords at any time using alter login. The system security officer can use alter login to change any user's password.

For example, to the password of the login account named ron, enter:

```
alter login ron with password watsMypaswd modify
password 8itsAsecret
```

See alter login in *Reference Manual: Commands*.

Requiring new passwords

You may choose to use the systemwide password expiration configuration parameter to establish a password expiration interval, which forces all Adaptive Server users to change their passwords on a regular basis. See Chapter 5, "Setting Configuration Parameters", in the *System Administration Guide: Volume 1*. Even if you do not use systemwide password expiration, it is important, for security reasons, that users change their passwords periodically.

The configuration parameter is superseded by the password policy settings.

password expiration interval specifies the password expiration interval in days. It can be any value between 0 and 32767, inclusive. For example, if you create a new login on August 1, 2007 at 10:30 a.m., with a password expiration interval of 30 days, the password expires on August 31, 2007 at 10:30 a.m.

The column pwdate in the syslogins table records the date of the last password change. The following query selects all login names whose passwords have not changed since September 15, 2007:

```
select name, pwdate
from syslogins
where pwdate < "Sep 15 2007"
```

Null passwords

Do not assign a null password. When Adaptive Server is installed, the default "sa" account has a null password. This example shows how to change a null password to a valid one:

```
alter login sa with password null modify password 8M4LNC
```

Note Do not enclose "null" in quotes in the statement.

Logging in after lost password

You can use dataserver -p*login_name* if your site encounters any of these situations:

- All system administrator login accounts are locked.
- All system security officer login accounts are locked.
- The password for sa_role or sso_role has been lost.

The dataserver parameter, with the -p parameter allows you to set a new password for these accounts and roles. *login_name* is the name of the user or the name of the role (sa_role or sso_role) for which the password must be reset.

When you start with the -p parameter, Adaptive Server generates, displays, and encrypts a random password and saves it in master..syslogins or in master..syssrvroles as that account or role's new password.

Sybase strongly recommends that you change the password when the server restarts. For example, to reset the password for user rsmith who has sa_role:

```
dataserver -prsmith
```

To reset the password of the sso_role:

```
dataserver -psso_role
```

Changing user session information

The set command includes options that allow you to assign each client an individual name, host name, and application name. This is useful for differentiating among clients in a system where many clients connect to Adaptive Server using the same name, host name, or application name.

The partial syntax for the set command is:

set [clientname *client_name* | clienthostname *host_name* |
clientapplname *application_name*]

where:

- *client_name* – is the name you are assigning the client.
- *host_name* – is the name of the host from which the client is connecting.
- *application_name* – is the application that is connecting to Adaptive Server.

These parameters are stored in the clientname, clienthostname, and clientapplname columns of the sysprocesses table.

For example, if a user logs in to Adaptive Server as "client1," you can assign them an individual client name, host name, and application name using commands similar to:

```
set clientname 'alison'
set clienthostname 'money1'
set clientapplname 'webserver2'
```

This user now appears in the sysprocesses table as user "alison" logging in from host "money1" and using the "webserver2" application. However, although the new names appear in sysprocesses, they are not used for permission checks, and sp_who still shows the client connection as belonging to the original login (in the case above, client1). set clientname does not perform the same function as set proxy, which allows you to assume the permissions, login name, and *suid* of another user.

You can set a client name, host name, or application name for only your current client session (although you can view the connection information for any client connection). Also, this information is lost when a user logs out. These parameters must be reassigned each time a user logs in. For example, the user "alison" cannot set the client name, host name, or application name for any other client connection.

Use the client's system process ID to view their connection information. For example, if the user "alison" described above connects with a *spid* of 13, issue the following command to view all the connection information for this user:

```
select * from sysprocesses where spid = 13
```

To view the connection information for the current client connection (for example, if the user "alison" wanted to view her own connection information), enter:

```
select * from sysprocesses where spid = @@spid
```

Dropping users and groups

A system administrator, system security officer, or database owner can use sp_dropuser or sp_dropgroup to drop users and groups from databases.

Dropping users

A database owner, system security officer, or a system administrator can use sp_dropuser to deny an Adaptive Server user access to the database in which sp_dropuser is executed. (If a "guest" user is defined in that database, the user can still access that database as "guest.")

The following is the syntax, where *name_in_db* is usually the login name, unless another name has been assigned with sp_adduser:

sp_dropuser *name_in_db*

You cannot drop a user who owns objects. Since there is no command to transfer ownership of objects, you must drop objects owned by a user before you drop the user. To deny access to a user who owns objects, use sp_locklogin to lock his or her account.

You also cannot drop a user who has granted permissions to other users. Use revoke with cascade to revoke permissions from all users who were granted permissions by the user to be dropped, then drop the user. You must then grant permissions to the users again, if appropriate.

Dropping groups

The system security officer, the system administrator, or the database administrator uses sp_dropgroup to drop a group. The syntax is:

```
sp_dropgroup grpname
```

You cannot drop a group that has members. If you try to do so, the error report displays a list of the members of the group you are attempting to drop. To remove users from a group, use sp_changegroup, discussed in "Changing a user's group membership" on page 71.

Monitoring license use

The License Use Monitor allows a system administrator to monitor the number of user licenses used in Adaptive Server, and to securely manage the license agreement data. That is, you can ensure that the number of licenses used on your Adaptive Server does not exceed the number specified in your license agreement.

The License Use Monitor tracks the number of licenses issued; it does not enforce the license agreement. If the License Use Monitor reports that you are using more user licenses than specified in your license agreement, see your Sybase sales representative.

You must have system administrator privileges to configure the License Use Monitor; by default the monitor is turned off when Adaptive Server is installed or upgraded.

See "Configuring the License Use Monitor," below.

How licenses are counted

A license is the combination of a host computer name and a user name. If a user logs in to Adaptive Server multiple times from the same host machine, one license is used. However, if the user logs in once from host A, and once from host B, two licenses are used. If multiple users log in to Adaptive Server from the same host, but with different user names, each distinct combination of user name and host name uses one license.

Configuring the License Use Monitor

Use sp_configure to specify the number of licenses in your license agreement, where *number* is the number of licenses:

```
sp_configure "license information" , number
```

This example sets the maximum number of user licenses to 300, and reports an overuse for license number 301:

```
sp_configure "license information", 300
```

If you increase the number of user licenses, you must also change the license information configuration parameter.

Monitoring license use with the housekeeper task

After you configure the License Use Monitor, the housekeeper task determines how many user licenses are in use, based on the user ID and the host name of each user logged in to Adaptive Server. The License Use Monitor updates a variable that tracks the maximum number of user licenses in use:

- If the number of licenses in use is the same or has decreased since the previous housekeeper run, the License Use Monitor does nothing.
- If the number of licenses in use has increased since the previous housekeeper run, the License Use Monitor sets this number as the maximum number of licenses in use.
- If the number of licenses in use is greater than the number allowed by the license agreement, the License Use Monitor issues this message to the error log:

  ```
  Exceeded license usage limit. Contact Sybase Sales
  for additional licenses.
  ```

The housekeeper chores task runs during Adaptive Server idle cycles. Both the housekeeper free write percent and the license information configuration parameter must be set to values greater than or equal to 1 for the License Use Monitor to track license use.

For more information about the housekeeper chores task, see Chapter 3, "Using Engines and CPUs," in the *Performance and Tuning Series:Basics*.

Logging the number of user licenses

The syblicenseslog system table is created in the master database when you install or upgrade Adaptive Server. The License Use Monitor updates the columns in syblicenseslog at the end of each 24-hour period, as shown in Table 3-10.

Table 3-10: Columns in syblicenseslog table

Column	Description
status	-1 – housekeeper cannot monitor licenses. 0 – number of licenses not exceeded. 1 – number of licensees exceeded.
logtime	Date and time the log information was inserted.
maxlicenses	Maximum number of licenses used during the previous 24 hours.

syblicenseslog looks similar to this:

```
status logdate                    maxlicenses
------ -------------------------- -----------
     0    Jul 17 1998 11:43AM         123
     0    Jul 18 1998 11:47AM         147
     1    Jul 19 1998 11:51AM         154
     0    Jul 20 1998 11:55AM         142
     0    Jul 21 1998 11:58AM         138
     0    Jul 21 1998  3:14PM         133
```

In this example, the number of user licenses used exceeded the limit on July 19, 1998.

If Adaptive Server is shut down, License Use Monitor updates syblicenseslog with the current maximum number of licenses used. Adaptive Server starts a new 24-hour monitoring period when it is restarted.

The second row for July 21, 1998 was caused by a shutdown and restart of the server.

Number of user and login IDs

Adaptive Server supports over 2,000,000,000 logins per server and users per database. Adaptive Server uses negative numbers as well as positive numbers to increase the range of possible numbers available for IDs.

Limits and ranges of ID numbers

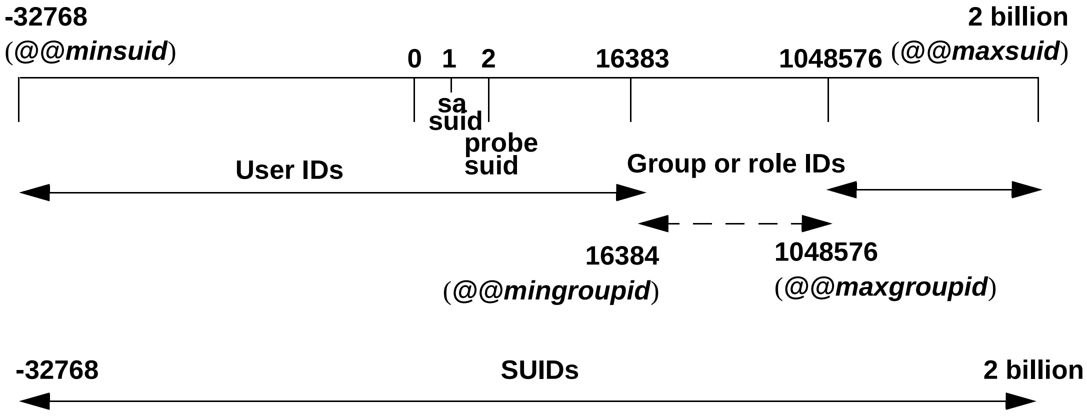
Table 3-11 describes the valid ranges for the ID types.

Table 3-11: Ranges for ID types

ID type	Server limits
Logins per server (*suid*)	2 billion plus 32K
Users per database (*uid*)	2 billion less 1032193
Groups or roles per database (*gid*)	16,384 to 1,048,576

Figure 3-1 illustrates the limits and ranges for logins, users, and groups.

Figure 3-1: Users, groups, and logins available in Adaptive Server



You may use negative values for user IDs (*uid*).

The server user ID (*suid*) associated with a group or a role in sysusers is not equal to the negation of their user ID (*uid*). Every *suid* associated with a group or a role in sysusers is set to -2 (INVALID_SUID).

Login connection limitations

Although Adaptive Server allows you to define more than two billion logins per server, the actual number of users that can connect to Adaptive Server at one time is limited by the:

- Value of the number of user connections configuration parameter, and
- Number of file descriptors available for Adaptive Server. Each login uses one file descriptor for the connection.

Note The maximum number of concurrent tasks running on the server is 32,000.

❖ Allowing the maximum number of logins and simultaneous connections

1. Configure the operating system on which Adaptive Server is running for at least 32,000 file descriptors.
2. Set the value of number of user connections to at least 32,000.

Note Before Adaptive Server can have more than 64K logins and simultaneous connections, you must first configure the operating system for more than 64K file descriptors. See your operating system documentation for information about increasing the number of file descriptors.

Table 3-12: Global variables for logins, users, and groups

Name of variable	What it displays	Value
@@invaliduserid	Invalid user ID	-1
@@minuserid	Lowest user ID	-32768
@@guestuserid	Guest user ID	2
@@mingroupid	Lowest group or role user ID	16384
@@maxgroupid	Highest group or role user ID	1048576
@@maxuserid	Highest user ID	2147483647
@@minsuid	Lowest server user ID	-32768
@@probesuid	Probe server user ID	2
@@maxsuid	Highest server user ID	2147483647

To issue a global variable, enter:

```
select variable_name
```

For example:

```
select @@minuserid
-----------
-32768
```

Getting information about usage: chargeback accounting

When a user logs in to Adaptive Server, the server begins accumulating CPU and I/O usage for that user. Adaptive Server can report total usage for an individual, or for all users. Information for each user is stored in the syslogins system table in the master database.

Reporting current usage statistics

The system administrator can use sp_reportstats or sp_clearstats to get or clear current total usage data for individuals or for all users on Adaptive Server.

Displaying current accounting totals

sp_reportstats displays current accounting totals for Adaptive Server users. It reports total CPU and total I/O, as well as the percentage of those resources used. It does not record statistics for the “sa” login (processes with an *suid* of 1), checkpoint, network, and mirror handlers.

Initiating a new accounting interval

Adaptive Server accumulates CPU and I/O statistics until you clear the totals from syslogins by running sp_clearstats. sp_clearstats initiates a new accounting interval for Adaptive Server users and executes sp_reportstats to print out statistics for the previous period.

Choose the length of your accounting interval by deciding how to use the statistics at your site. For example, to do monthly cross-department charging for the percentage of Adaptive Server CPU and I/O usage, run sp_clearstats once a month.

For detailed information about these stored procedures, see the *Reference Manual: Procedures*.

Specifying the interval for adding accounting statistics

A system administrator can use configuration parameters to decide how often accounting statistics are added to syslogins.

To specify how many machine clock ticks accumulate before accounting statistics are added to syslogins, use the cpu accounting flush interval configuration parameter. The default value is 200. For example:

```
sp_configure "cpu accounting flush interval", 600
```

To find out how many microseconds a tick is on your system, run the following query in Adaptive Server:

```
select @@timeticks
```

To specify how many read or write I/Os accumulate before the information is added (flushed) to syslogins, use the i/o accounting flush interval configuration parameter. The default value is 1000. For example:

```
sp_configure "i/o accounting flush interval", 2000
```

I/O and CPU statistics are flushed when a user accumulates more I/O or CPU usage than the specified value. The information is also flushed when the user exits an Adaptive Server session.

The minimum value allowed for either configuration parameter is 1. The maximum value allowed is 2,147,483,647.

CHAPTER 4 External Authentication

This chapter describes the Adaptive Server features that enable you to authenticate users with authentication data stored in repositories that are external to Adaptive Server.

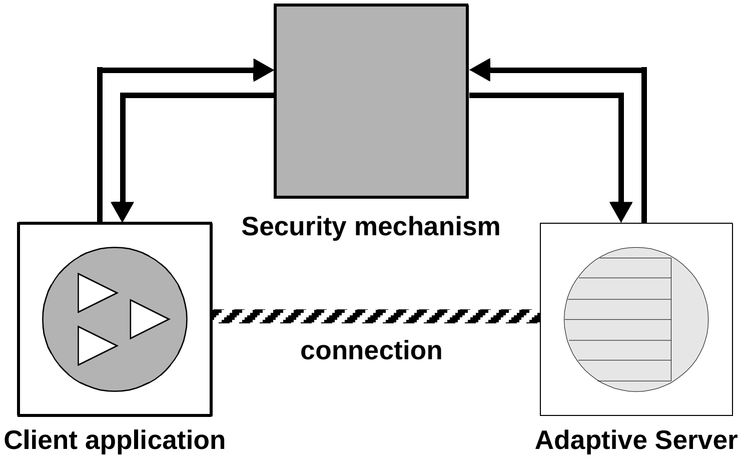
You can enhance the security for large, heterogeneous applications by authenticating logins with a central repository. Adaptive Server supports these external authentication methods:

- Kerberos – provides a centralized and secure authentication mechanism in enterprise environments that employ the Kerberos infrastructure. Authentication occurs with a trusted, third-party server called a key distribution center (KDC) that verifies both the client and the server.
- LDAP user authentication – Lightweight Directory Access Protocol (LDAP) provides a centralized authentication mechanism based on a user’s login name and password.
- PAM user authentication – Pluggable Authentication Module (PAM) provides a centralized authentication mechanism that uses interfaces provided by the operating system for administration and runtime application interfaces.

Configuring Adaptive Server for network-based security

The secure connection between a client and a server can be used for login authentication and message protection.

Figure 4-1: Establishing secure connections between a client and Adaptive Server



If a client requests authentication services:

1. The client validates the login with the security mechanism. The security mechanism returns a credential, which contains security-relevant information.
2. The client sends the credential to Adaptive Server.
3. Adaptive Server authenticates the client's credential with the security mechanism. If the credential is valid, a secure connection is established between the client and Adaptive Server.

If the client requests message protection services:

1. The client uses the security mechanism to prepare the data packet it sends to Adaptive Server.

   Depending upon which security services are requested, the security mechanism might encrypt the data or create a cryptographic signature associated with the data.
2. The client sends the data packet to Adaptive Server.

3 Upon receiving the data packet, Adaptive Server uses the security mechanism to perform any required decryption and validation.

4 Adaptive Server returns results to the client, using the security mechanism to perform the security functions that were requested; for example, Adaptive Server may return the results in encrypted form.

Security services and Adaptive Server

Depending on the security mechanism you choose, Adaptive Server allows you to use one or more of these security services:

- Unified login – authenticates users once, without requiring them to supply a name and password every time they log in to an Adaptive Server.
- Message confidentiality – encrypts data over the network.
- Mutual authentication – verifies the identity of the client and the server. Mutual authentication can be requested only by the client; it cannot be required by Adaptive Server.
- Message integrity – verifies that data communications have not been modified.
- Replay detection – verifies that data has not been intercepted by an intruder.
- Out-of-sequence check – verifies the order of data communications.
- Message origin checks – verifies the origin of the message.
- Credential delegation – allows the client to delegate the credential to the Adaptive server to enable secure connection with remote servers. This service is supported by Kerberos security mechanism. Adaptive server currently supports this for connections to remote Adaptive server through CIS.

- Remote procedure security – establishes mutual authentication, message confidentiality, and message integrity for remote procedure communications through CIS for Kerberos connections.

Note The security mechanism you are using may not employ all of these services. See "Getting information about available security services" on page 108.

Administering network-based security

Table 4-1 provides an overall process for using the network-based security functions provided by Adaptive Server. You must install Adaptive Server before you can complete the steps in Table 4-1.

Table 4-1: Administering network-based security

Step	Description	See
1. Set up configuration files: • *libtcl.cfg* • *objectid.dat* • *interfaces* (or directory service)	Edit the *libtcl.cfg* file. Edit the *objectid.dat* file. Edit the *interfaces* file or Directory Service.	• "Setting up configuration files for security" on page 95 • The *Open Client/Server Configuration Guide* for your platform
2. Make sure the security administrator for the security mechanism has created logins for each user and for the Adaptive Server and Backup Server.	The security administrator must add names and passwords for users and servers in the security mechanism.	• The documentation supplied with your security mechanism • "Identifying users and servers to the security mechanism" on page 100
3. Configure security for your installation.	Use sp_configure.	"Configuring Adaptive Server for security" on page 100
4. Restart Adaptive Server.	Activates the use security services parameter.	The *Configuration Guide* for your platform
5. Add logins to Adaptive Server to support enterprise-wide login.	Use create login to add login accounts. Optionally, specify a default secure login with sp_configure.	"Adding logins to support unified login" on page 104
6. Enable security mechanism for required remote servers.	Use security mechanism option of sp_serveroption to enable security mechanism for required remote servers.	"Establishing Kerberos security for remote connections" on page 105

Step	Description	See
7. Connect to the server and use security services.	Use isql_r or Open Client Client-Library to connect to Adaptive Server, specifying the security services you want to use.	• "Connecting to the server and using the security services" on page 107 • The *Open Client/Server Configuration Guide* for your platform • "Security Features" in the *Open Client Client-Library/C Reference Manual*
8. Check the security services and security mechanisms that are available.	Use the functions show_sec_services and is_sec_services_on to check which security services are available. For a list of security mechanisms and their security services supported by Adaptive Server, use select to query the syssecmechs system table.	"Getting information about available security services" on page 108

Setting up configuration files for security

Configuration files are created during installation at a default location in the Sybase directory structure.

Table 4-2: Names and locations for configuration files

File name	Description	Location
libtcl.cfg	The driver configuration file contains information regarding directory, security, and network drivers, and any required initialization information.	*UNIX platforms*: *$SYBASE/$SYBASE_OCS/config* *Windows platforms*: *%SYBASE%\%SYBASE_OCS%\ini*
objectid.dat	The object identifiers file maps global object identifiers to local names for character set, collating sequence, and security mechanisms.	*UNIX platforms*: *$SYBASE/config* *Windows platforms*: *%SYBASE%\ini*
UNIX: *interfaces* *Desktop platforms*: *sql.ini*	The *interfaces* file contains connection and security information for each server listed in the file. **Note** In Adaptive Server version 12.5.1 and later, you can use a Directory Service instead of the *interfaces* file.	*UNIX platforms*: *$SYBASE* *Desktop platforms*: *SYBASE_home\ini*

For a detailed description of the configuration files, see the *Open Client/Server Configuration Guide* for your platform.

Specifying security information for the server

Use an *interfaces* file or a Directory Service to provide information about the servers in your installation.

The *interfaces* file contains network and security information for servers. To use security services, the *interfaces* file must include line for "secmech" that specifies the global identifier or identifiers of the security services you plan to use.

Adaptive Server supports Directory Services to keep track of information about servers. A Directory Service manages the creation, modification, and retrieval of information about network servers. The advantage of using a Directory Service is that you do not need to update multiple *interfaces* files when a new server is added to your network or when a server moves to a new address. To use security services with a Directory Service, you must define the secmech security attribute to point to one or more global identifiers of the security services you plan to use.

UNIX tools for specifying the security mechanism

To specify the security mechanism or mechanisms:

- If you are using the *interfaces* file, use the dscp utility.
- If you are using a Directory Service, use the dscp_r utility.

Note The dsedit tool, which helps you create entries for either the *interfaces* file or a Directory Service, is available on UNIX platforms. However, it does not support the creation of secmech entries for security mechanisms.

For more information about dscp, see the *Open Client/Server Configuration Guide for UNIX*.

Desktop tools for specifying server attributes

To provide information about the servers for your installation in the sql.ini file or a Directory Service, use the dsedit utility. This utility provides a graphical user interface for specifying server attributes such as the server version, name, and security mechanism. For the security mechanism attribute, you can specify one or more object identifiers for the security mechanisms you plan to use. For information about using dsedit, see the *Open Client/Server Configuration Guide for Desktop Platforms*.

Preparing *libtcl.cfg* to use network-based security

libtcl.cfg and *libtcl64.cfg* (for 64-bit applications) contain information about three types of drivers:

- Network (Net-Library)
- Directory Services
- Security

A **driver** is a Sybase library that provides an interface to an external service provider. Drivers are dynamically loaded so that you can change the driver used by an application without relinking the application.

Entries for network drivers

The syntax for a network driver entry is:

driver=protocol description

where:

- *driver* – is the name of the network driver.
- *protocol* – is the name of the network protocol.
- *description* – is a description of the entry. This element is optional.

Note If you do not specify a network driver, an appropriate driver for your application and platform is automatically used. For example, for UNIX platforms, a driver that can handle threads is automatically chosen when security services are being used.

Entries for Directory Services

Directory Services entries apply if you want to use a Directory Service instead of the *interfaces* file. See the configuration documentation for your platform, and the *Open Client/Server Configuration Guide* for your platform.

Entries for security drivers

The syntax for a security driver entry is:

provider=driver init-string

where:

- *provider* – is the local name for the security mechanism. The mapping of the local name to a global object identifier is defined in *objectid.dat*.

  The default local names are:

  - "csfkrb5" – for the CyberSAFE or MIT Kerberos security mechanism.
  - "LIBSMSSP" – for Windows LAN Manager on Windows NT or Windows 95 (clients only).

If you use a local mechanism name other than the default, change the local name in the objectid.dat file (For an example, see "The objectid.dat file" on page 99).

- *driver* – is the name of the security driver. The default location of all drivers for UNIX platforms is *$SYBASE/$SYBASE_OCS/lib*. The default location for Windows platform is *%SYBASE%\%SYBASE_OCS%\dll*.
- *init-string* – is an initialization string for the driver. This element is optional. The value for *init-string* varies by driver:
  - Kerberos driver – the following is the syntax for *init-string*, where *realm* is the default Kerberos realm name:

    secbase=@*realm*
  - Windows NT LAN Manager – *init-string* is not applicable.

UNIX platform information

No special tools for editing the *libtcl.cfg* file are available. Use your favorite editor to comment and uncomment the entries that are already in place after you install Adaptive Server.

After you install Adaptive Server on a UNIX platform, the *libtcl.cfg* file already contains entries for the three sections of the file:

- [DRIVERS]
- [DIRECTORY]
- [SECURITY]

The sections do not have to be in a specific order.

Make sure that the entries you do not want to use are commented (begin with ";") and the entries you want are uncommented (do not begin with ";").

For more information, see the *Open Client/Server Configuration Guide for UNIX*

Sample *libtcl.cfg* for Sun Solaris

```
[DRIVERS]
;libtli.so=tcp unused ; This is the non-threaded tli driver.
;libtli_r.so=tcp unused ; This is the threaded tli driver.

[SECURITY]
csfkrb5=libsybskrb.so secbase=@MYREALM libgss=/krb5/lib/libgss.so
```

This file does not use Directory Services because all [DIRECTORY] section entries are commented.

Because all entries in the [DRIVERS] section for network drivers are also commented, appropriate drivers are automatically chosen by the system. Adaptive Server automatically chooses a threaded driver when you use security services, and chooses an unthreaded driver for applications that cannot work with threaded drivers. For example, Backup Server does not support security services and does not work with a threaded driver.

Desktop platform information

The ocscfg utility automatically creates section headings for the *libtcl.cfg* file; you can also use osccfg to edit the *libtcl.cfg* file.

This is a sample *libtcl.cfg* file for desktop platforms:

```
[NT_DIRECTORY]
ntreg_dsa=LIBDREG  ditbase=software\sybase\serverdsa

[DRIVERS]
NLWNSCK=TCP  Winsock TCP/IP Net-Lib driver
NLMSNMP=NAMEPIPE  Named Pipe Net-Lib driver
NLNWLINK=SPX  NT NWLINK SPX/IPX Net-Lib driver
NLDECNET=DECNET  DecNET Net-Lib driver

[SECURITY]
NTLM=LIBSMSSP
```

See the *Open Client/Server Configuration Guide for Desktop Platforms*.

The *objectid.dat* file

The objectid.dat file maps global object identifiers to local names, such as the one for the Kerberos service (for example, an identifier like 1.3.6.1.4.1.897.4.6.6) to local names, such as “csfkrb5”. The objectid.dat file contains sections such as [CHARSET] for character sets and [SECURITY] for security services. Following is a sample objectid.dat file:

```
secmech]
       1.3.6.1.4.1.897.4.6.3   = NTLM
       1.3.6.1.4.1.897.4.6.6   = csfkrb5
```

Use a text editor to change this file only if you have changed the local name of a security service in the *libtcl.cfg* file.

For example, if you changed:

```
[SECURITY]
csfkrb5=libsybskrb.so secbase=@MYREALM
libgss=/krb5/lib/libgss.so
```

to:

```
[SECURITY]
csfkrb5_group=libsybskrb.so secbase=@MYREALM
libgss=/krb5/lib/libgss.so
```

Change the objectid.dat in *libtcl.cfg* to reflect the change. Simply change the local name in the line for Kerberos in objectid.dat:

```
1.3.6.1.4.1.897.4.6.6 = csfkrb5_group
```

Note You can specify only one local name per security mechanism.

Identifying users and servers to the security mechanism

The security administrator for the security mechanism must define principals (both users and servers) to the security mechanism. The tools you can use to add users and servers are:

- Kerberos – see your Kerberos vendor-specific tools for information about defining users and servers. See “Using Kerberos” on page 110 for more information about Kerberos and Adaptive Server.
- Windows NT LAN Manager – run the User Manager tool to define users to the Windows NT LAN Manager. Define the Adaptive Server name as a user to Windows NT LAN Manager and display Adaptive Server as that user name.

Note In a production environment, control access to files that contain the keys of the servers and users. If users can access the keys, they can create a server that impersonates your server.

See the documentation available from the third-party provider of the security mechanism for detailed information about how to perform required administrative tasks.

Configuring Adaptive Server for security

Adaptive Server includes several configuration parameters for administering network-based security. To set these parameters, you must be a system security officer. All parameters for network-based security are part of the “Security-Related” configuration parameter group.

Enabling network-based security

To enable or disable network-based security, use sp_configure to set the use security services configuration parameter. .

If use security services is set to 1, Adaptive Server supports a security mechanism when both of the following circumstances are true:

- The security mechanism's global identifier is listed in the *interfaces* file or Directory Service.
- The global identifier is mapped in *objectid.dat* to a local name that is listed in *libtcl.cfg*.

For information about how Adaptive Server determines which security mechanism to use for a particular client, see "Using security mechanisms for the client" on page 108.

Requiring unified login

To require all users, other than the system security officer, to be authenticated by a security mechanism, set the unified login required configuration parameter to 1. Only the user with the sso_role can log in to the server with a user name and password when this configuration parameter is set:

sp_configure "unified login required", [0|1]

For example, to require all logins to be authenticated by a security mechanism, execute:

```
sp_configure "unified login required", 1
```

Establishing a secure default login

When a user with a valid credential from a security mechanism logs in to Adaptive Server, the server checks whether the user name exists in master..syslogins. If it does, Adaptive Server uses that user name. For example, if a user logs in to the Kerberos security mechanism as "ralph," and "ralph" is in master..syslogins, Adaptive Server uses all roles and authorizations defined for "ralph" in the server.

However, if a user with a valid credential logs in to Adaptive Server, but is unknown to the server, the login is accepted only if a secure default login is defined with sp_configure. Adaptive Server uses the default login for any user who is not defined in master..syslogins, but who is preauthenticated by a security mechanism. The syntax is:

sp_configure "secure default login", 0, *login_name*

The default value for secure default login is “guest.”

A secure default login must also be a valid login in master..syslogins. For example, to set the “gen_auth” as the default login:

1 Use create login to add the login as a valid user in Adaptive Server:

```
create login gen_auth with password pwgenau
```

This procedure sets the initial password to “pwgenau”.

2 Designate the login as the security default:

```
sp_configure "secure default login", 0, gen_auth
```

Adaptive Server uses this login for a user who is preauthenticated by a security mechanism but is unknown to Adaptive Server.

Note More than one user can assume the suid associated with the secure default login. Therefore, you might want to activate auditing for all activities of the default login. You may also want to consider using create loign to add all users to the server.

See “Creating login accounts” on page 17.

Mapping security mechanism login names to server names

Some security mechanisms may allow login names that are invalid in Adaptive Server. For example, login names that are longer than 30 characters, or login names containing special characters such as !, %, *, and & are invalid in Adaptive Server. All login names in Adaptive Server must be valid identifiers. See Chapter 3, “Expressions, Identifiers, and Wildcard Characters,” in the *Reference Manual*.

Table 4-3 shows how Adaptive Server converts invalid characters in login names:

Table 4-3: Conversion of invalid characters in login names

Invalid characters	Converts to
Ampersand & Apostrophe ’ Backslash \ Colon : Comma , Equals sign = Left quote ‘ Percent % Right angle bracket > Right quote ’ Tilde ~	Underscore _
Caret ^ Curly braces { } Exclamation point ! Left angle bracket < Parenthesis ( ) Period . Question mark ?	Dollar sign $
Asterisk * Minus sign - Pipe | Plus sign + Quotation marks " Semicolon ; Slash / Square brackets [ ]	Pound sign #

Requiring message confidentiality with encryption

To require all messages into and out of Adaptive Server to be encrypted, set the msg confidentiality reqd configuration parameter to 1. If this parameter is 0 (the default), message confidentiality is not required but may be established by the client. The syntax is:

sp_configure *configuration_parameter*, [0 | 1]

For example, to require that all messages be encrypted, execute:

```
sp_configure "msg confidentiality reqd", 1
```

Requiring data integrity

Adaptive Server allows you to use the msg integrity reqd configuration parameter to require that one or more types of data integrity be checked for all messages. Set msg integrity reqd to 1 to require that all messages be checked for general tampering. If msg integrity reqd is 0 (the default), message integrity is not required but may be established by the client if the security mechanism supports it.

Memory requirements for network-based security

Allocate approximately 2K additional memory per secure connection. The value of the max total_memory configuration parameter specifies the amount of memory that Adaptive Server requires at start-up. For example, if your server uses 2K logical pages, and if you expect the maximum number of secure connections occurring at the same time to be 150, increase the max total_memory parameter by 150, which increases memory allocation by 150 2K blocks.

The syntax is:

sp_configure “max total_memory”, *value*

For example, if Adaptive Server requires 75,000 2K blocks of memory, including the increased memory for network-based security, execute:

```
sp_configure "max total_memory", 75000
```

See Chapter 3, “Configuring Memory,” in *System Administration Guide: Volume 2*.

Adding logins to support unified login

When users log in to Adaptive Server with a preauthenticated credential, Adaptive Server:

1. Checks whether the user is a valid user in master..syslogins. If the user is listed in master..syslogins, Adaptive Server accepts the login without requiring a password.
2. If the user name is not in master..syslogins, Adaptive Server checks whether a default secure login is defined. If the default login is defined, the user is logged in successfully using the default. If a default login is not defined, the user cannot log in.

Therefore, consider whether you want to allow only those users who are defined as valid logins to use Adaptive Server, or whether you want users to be able to log in with the default login. To define the default, add the default login in master..syslogins and use sp_configure. See "Establishing a secure default login" on page 101.

General procedure for adding logins

Follow the general procedure described in Table 4-4 to add logins to the server and, optionally, to add users with appropriate roles and authorizations to one or more databases.

Table 4-4: Adding logins and authorizing database access

Task	Required role	Command or procedure	See
1. Add a login for the user.	System security officer	create login	"Creating login accounts" on page 17
2. Add the user to one or more databases.	System administrator or Database owner	sp_adduser – execute this procedure from within the database.	"Adding users to databases" on page 66
3. Add the user to a group in a database.	System administrator or Database owner	sp_changegroup – execute this procedure from within the database.	• "Changing a user's group membership" on page 71 • sp_changegroup in the *Reference Manual*
4. Grant system roles to the user.	System administrator or system security officer	grant role	• "Granting and revoking roles" on page 167 • grant in the *Reference Manual*
5. Create user-defined roles and grant the roles to users.	System security officer	create role grant role	• "Creating and assigning roles to users" on page 151 • grant in the *Reference Manual* • create role in the *Reference Manual*
6. Grant access to database objects.	Database object owners		Chapter 6, "Managing User Permissions"

Establishing Kerberos security for remote connections

Adaptive Server acts as the client when it connects to another server to execute a remote procedure call (RPC) and for remote connections through Component Integration services (CIS).

For remote server logins through Adaptive server for RPC execution, one physical connection is established between the two servers. The servers use the physical connection to establish one or more logical connections—one logical connection for each RPC.

Adaptive server supports end-to-end Kerberos authentication for Kerberos logins that attempt remote server connections through CIS using the credential delegation feature provided by Kerberos version 5.

The credential delegation or ticket forwarding allows a Kerberos client to delegate the credential when connecting to a server, thereby allowing the server to initiate Kerberos authentication for further connections to other servers on behalf of Kerberos client.

A Kerberos client connected to Adaptive server can request a Remote Procedure Call (RPC) to Adaptive Server, and for general distributed query processing requests to a remote Adapter Server through CIS by using the Kerberos credential delegation feature. The Kerberos authentication feature used for connections to remote Adaptive servers is not supported for remote server logins. For information about configuring CIS Kerberos Authentication, see “Configuration for Component Integration Services Remote Procedure Calls,” in Chapter 2, “Understanding Component Integration Services” in the *Component Integration Services User Guide*.

Unified login and the remote server logins

If the local server and remote server are set up to use security services, you can use unified login on both servers using one of these two methods:

- The system security officer defines a user as “trusted” with sp_remoteoption on the remote server. The user gains access to the local server using a “unified login” and executes an RPC on the remote server. The user is trusted on the remote server and does not need to supply a password.
- A user specifies a password for the remote server when he or she connects to the local server. The facility to specify a remote server password is provided by the ct_remote_pwd routine available with Open Client Client-Library/C. See the *Open Client Client-Library/C Reference Manual*.

Getting information about remote servers

sp_helpserver displays information about servers. When you run sp_helpserver without an argument, it provides information about all the servers listed in sysservers. You can specify a particular server to receive information about that server. The syntax is:

sp_helpserver [*server*]

For example, to display information about the GATEWAY server, execute:

```
sp_helpserver GATEWAY
```

Connecting to the server and using the security services

The isql and bcp utilities include the following command line options to enable network-based security services on the connection:

- -R *remote_server_principal*
- -V *security_options*
- -Z *security_mechanism*

These options are described in the following paragraphs.

- -R *remote_server_principal* – specifies the principal name for the server as defined to the security mechanism. By default, a server's principal name matches the server's network name (which is specified with the -S option or the DSQUERY environment variable). The -R option must be used when the server's principal name and network name are not the same.
- -V *security_options* – specifies network-based user authentication. With this option, the user must log in to the network's security system before running the utility. In this case, if a user specifies the -U option, the user must supply the network user name known to the security mechanism; any password supplied with the -P option is ignored. -V can be followed by a *security_options* string of key-letter options to enable additional security services. These key letters are:
  - c – enables data confidentiality service.
  - d – requests credential delegation and forwards client credentials.
  - i – enables data integrity service.
  - m – enables mutual authentication for connection establishment.
  - o – enables data origin stamping service.

    - r – enables data replay detection.
    - q – enables out-of-sequence detection.
- -Z *security_mechanism* – specifies the name of a security mechanism to use on the connection.

Security mechanism names are defined in the *libtcl.cfg* configuration file. If no *security_mechanism* name is supplied, the default mechanism is used. See the *Open Client/Server Configuration Guide* for your platform.

If you are using Client-Library to connect to Adaptive Server, you can define security properties before connecting to the server. For example, to check message sequencing, set the CS_SEC_DETECTSEQ property. For information about using security services with Client-Library, see the *Open Client Client-Library/C Reference Manual*.

Using security mechanisms for the client

Adaptive Server, when it is started, determines the set of security mechanisms it supports. See "Determining supported security services and mechanisms" on page 108. From the list of supported security mechanisms, Adaptive Server must choose the one to be used for a particular client.

If the client specifies a security mechanism (for example with the -Z option of isql), Adaptive Server uses that security mechanism. Otherwise, it uses the first security mechanism listed in the *libtcl.cfg* file.

Getting information about available security services

Adaptive Server lets you determine:

- What security mechanisms and services are supported by Adaptive Server
- What security services are active for the current session
- Whether a particular security service is enabled for the session

Determining supported security services and mechanisms

A system table, syssecmechs, provides information about the security mechanisms and security services supported by Adaptive Server. The table, which is dynamically built when you query it, contains these columns:

- sec_mech_name – is the name of the security mechanism; for example, the security mechanism might be “NT LANMANAGER.”
- available_service – is the name of a security service supported by the security mechanism; for example, the security service might be “unified login.”

The table may have several rows for a single security mechanism: one row for each security service supported by the mechanism.

To list all the security mechanisms and services supported by Adaptive Server, run:

```
select * from syssecmechs
```

Determining active security services

To determine which security services are active for the current session, use the function show_sec_services:

```
select show_sec_services()
```

```
--------------------------------------------------
        unifiedlogin mutualauth confidentiality
(1 row affected)
```

Determining whether a security service Is enabled

To determine whether a particular security service, such as “mutualauth” is enabled, use the function is_sec_service_on, where *security_service_nm* is a security service that is available:

is_sec_service_on(*security_service_nm*)

Use the security server that is returned when you query syssecmechs.

For example, to determine whether “mutualauth” is enabled, execute:

```
select is_sec_service_on("mutualauth")
```

```
-----------
          1
(1 row affected)
```

A result of 1 indicates the security service is enabled for the session. A result of 0 indicates the service is not in use.

Using Kerberos

Kerberos is a network authentication protocol that uses secret-key cryptography so that a client can prove its identity to a server across a network connection. User credentials are obtained when the user logs in to the operating system, or by executing an authentication program. Each application uses these credentials to perform authentication. Users only have to log in once, instead of having to log in to each application.

Kerberos assumes the key distribution center (KDC) is running and properly configured for your realm, and the client libraries are installed under or on each client host in your realm. For configuration information, consult the documentation and the reference pages that come with the Kerberos software.

Adaptive Server supports Kerberos through:

- CyberSafe Kerberos libraries
- MIT Kerberos libraries, version 1.3.1
- Native libraries

Note To enable Kerberos security options, you must have ASE_SECDIR, the "Security and directory services" package.

Kerberos compatibility

Table 4-5 shows which variation of Kerberos is supported on which platforms.

Table 4-5: Adaptive Server Kerberos interoperability

Hardware platforms	KDC server	Generic security standard (GSS) client
Solaris 32	CSF, AD, MIT	CSF, MIT, Native
Solaris 64	CSF, AD, MIT	CSF, MIT, Native
Linux 32	CSF, AD, MIT	MIT, Native
Windows 32	CSF, AD	CSF
AIX 32	CSF	CSF

Use the following keys to read the interoperability matrix:

- CSF – CyberSafe Ltd.
- AD – Microsoft Active Directory
- MIT – MIT version 1.3.1

Starting Adaptive Server under Kerberos

To start Adaptive Server under Kerberos, add the Adaptive Server name to the KDC and extract the service key to a key table file. For example:

```
/krb5/bin/admin admin/ASE -k -t /krb5/v5srvtab -R”
addrn my_ase; mod
my_ase attr nopwchg; ext -n my_ase eytabfile.krb5”
Connecting as: admin/ASE
Connected to csfA5v01 in realm ASE.
Principal added.
Principal modified.
Key extracted.
Disconnected.
```

Note The administrator can also be authenticated using a password on the command line. In this example, the -k option is used, which tells the administrator to search the */krb5/v5srvtab* file (specified using the -t option) for the administrator and the Adaptive Server key, instead of prompting for a password, which is useful for writing shell scripts.

Configuring Kerberos

The configuration process is similar, regardless of which variety of Kerberos you use.

1. Set up Kerberos third-party software and create a Kerberos administrative user. To do this, you must:

   a. Install Kerberos client software on machines where Open Client Server clients or Adaptive Server will run. The following client packages have been verified to work with:

      - CyberSafe TrustBroker 4.0
      - MIT Kerberos version 1.3.1

   b. Install the Kerberos KDC server on a separate, dedicated machine.

   Note KDCs from CyberSafe TrustBroker 4.0, MIT Kerberos v.1.3.1, and Microsoft Windows Active Directory have been verified for use with Adaptive Server.

   ---

c. Create an administrator account with administration privileges on the Kerberos server. This account is used for subsequent client actions such as creating principals from the client machines.

Note Execute the remainder of these steps on the Kerberos client machine.

---

2. Add Kerberos principal for Adaptive Server *ase120srv* or *ase120srv@MYREALM*.

3. Extract the *keytab* file for principal *ase120srv@MYREALM* and store it as a file:

```
/krb5/v5srvtab
```

The following UNIX examples use the command line tool kadmin, available with CyberSafe or MIT Kerberos (there are also GUI tools available to administer Kerberos and users):

```
CyberSafe Kadmin:
% kadmin aseadmin
Principal - aseadmin@MYREALM
Enter password:
Connected to csfA5v01 in realm ASE.
Command: add ase120srv
Enter password:
Re-enter password for verification:
Principal added.
Command: ext -n ase120srv
Service Key Table File Name (/krb5/v5srvtab):
Key extracted.
Command: quit
Disconnected.
```

In a production environment, control the access to the *keytab* file. If a user can read the *keytab* file, he or she can create a server that impersonates your server.

Use chmod and chgrp so that */krb5/v5srvtab* is:

```
-rw-r----- 1 root sybase 45 Feb 27 15:42 /krb5/v5srvtab
```

When using Active Directory as the KDC, log in to the Domain Controller to add users and Adaptive Server principals. Use the Active Directory Users and Computers wizard to guide you through creating users and principals.

Extracting the *keytab* file for use with Adaptive Server requires an optional tool called ktpass, which is included in the Microsoft Support Tools package.

With Active Directory, extracting the *keytab* with ktpass is a separate step from creating the principal. The *keytab* file on Windows for Adaptive Server is located with the CyberSafe program files. For example, *c:\Program Files\CyberSafe\v5srvtab* is the expected location of the Adaptive Server *keytab* file when CyberSafe software is installed on the C: drive.

4. Add a Kerberos principal for the user “sybuser1” as “sybuser1@MYREALM”.

5. Start Adaptive Server and use isql to log in as “sa”. The following steps configure Adaptive Server parameters to use Kerberos security services, and create the user login account. These are the same on both Windows or UNIX machines:

   - Change configuration parameter use security services to 1:

     ```
     sp_configure 'use security services', 1
     ```

   - Add a new login for user, “sybuser1” and then add the user:

     ```
     create login sybuser1 with password password
     ```

6. Shut down Adaptive Server and modify administrative files and connectivity configuration files.

   - On UNIX platforms – the *interfaces* file is under *$SYBASE/* and has an entry that looks similar to:

     ```
     ase120srv
           master tli tcp myhost 2524
           query tli tcp myhost 2524
           secmech 1.3.6.1.4.1.897.4.6.6
     ```

     On Windows platforms – the *sql.ini* file is in *%SYBASE%\ini*, and has an equivalent server entry that looks like:

     ```
     [ase120srv]
     master=TCP,myhost,2524
     query=TCP,myhost,2524
     secmech=1.3.6.1.4.1.897.4.6.6
     ```

- The *libtcl.cfg* or *libtcl64.cfg* file is located in *$SYBASE/$SYBASE_OCS/config/* on UNIX platforms.The SECURITY section should have an entry that looks similar to the following for CyberSafe Kerberos client libraries:

  ```
  [SECURITY]
  csfkrb5=libsybskrb.so secbase=@MYREALM
  libgss=/krb5/lib/libgss.so
  ```

  A 64-bit CyberSafe Kerberos client library entry follows:

  ```
  [SECURITY]
  csfkrb5=libsybskrb64.so secbase=@MYREALM libgss=
  \
  /krb5/appsec-rt/lib/64/libgss.so
  ```

  For a machine that uses MIT Kerberos client libraries, the entry looks something like:

  ```
  [SECURITY]
  csfkrb5=libsybskrb.so
  secbase=@MYREALM
  libgss=/opt/mitkrb5/lib/libgssapi_krb5.so
  ```

  For a machine that uses Native OS provided libraries, such as Linux, it looks similar to:

  ```
  [SECURITY]
  csfkrb5=libsybskrb.so secbase=@MYREALM
  libgss=/usr/kerberos/lib/libgssapi_krb5.so
  ```

  On Windows – the *%SYBASE%\%SYBASE_OCS%\ini\libtcl.cfg* file contains an entry like:

  ```
  [SECURITY]
  csfkrb5=libskrb secbase=@MYREALM
  libgss=C:\WinNT\System32\gssapi32.dll
  ```

  Note The `libgss=<gss shared object path>` specifies the GSS API library to be used. You must distinctly locate the Kerberos Client libraries being used, especially when multiple versions are installed on a machine.

- Also check the *objectid.dat* under *$SYBASE/$SYBASE_OCS/config/* and make sure the *[secmech]* section has an entry for *csfkrb5*:

  ```
  [secmech]
  1.3.6.1.4.1.897.4.6.6 = csfkrb5
  ```

7 You can use environment variables to override default locations of *keytab* files, Kerberos configuration, and realm configuration files. This is Kerberos-specific behavior and may not work consistently on all platforms.

For example, use the CSFC5KTNAME environment variable on CyberSafe UNIX platforms to specify the *keytab* file:

```
% setenv CSFC5KTNAME /krb5/v5srvtab
```

For MIT Kerberos, the equivalent environment variable is KRB5_KTNAME.

See the vendor documentation for information about these environment variables.

You may may need to modify the environment variable for dynamic library search paths. On UNIX, the most commonly used environment variable is LD_LIBRARY_PATH; on Windows, PATH is typically set to include DLL locations. You may need to modify these environment variables to enable applications to load the third-party objects correctly. For example, this command adds the location of CyberSafe 32-bit *libgss.so* shared object to the search path in a C-shell environment:

```
% set path = ( /krb5/lib $path )
```

8 Restart Adaptive Server. You should see:

```
00:00000:00000:2001/07/25 11:43:09.91 server
Successfully initialized the security mechanism
'csfkrb5'. The SQL Server will support use of this
security mechanism.
```

9 Use isql as UNIX user “sybuser1” (without the -U and -P arguments) to connect:

```
% $SYBASE/$SYBASE_OCS/bin/isql -Sase120srv -V
1>...
```

You can also use the encryption option:

```
$SYBASE/$SYBASE_OCS/bin/isql -Sase120srv –Vc
```

Using principal names

The principal name is the name the server uses to authenticate with the Kerberos key distribution center (KDC). When you have multiple instances of Adaptive Server running, you must have different principal names for each Adaptive Server.

Specifying the Adaptive Server principal name

Use the DSLISTEN and DSQUERY environment variables, or the dataserver -s*server_name* command line option to specify the Adaptive Server name.

Use either the setenv command or the -k dataserver option to set the principal name.

By default, the principal name is the name of Adaptive Server. To specify a different name, set SYBASE_PRINCIPAL before starting Adaptive Server to use Kerberos:

```
setenv SYBASE_PRINCIPAL <name of principal>
```

Once you have set an Adaptive Server principal name, Adaptive Server uses the value of this variable to authenticate itself to Kerberos.

To specify an Adaptive Server principal name when starting Adaptive Server, use:

```
-k <server principal name>
```

When you start an Adaptive Server with the Kerberos security mechanism enabled, Adaptive Server first uses the principal name specified with the -k option for Kerberos authentication. If the -k option is not specified, Adaptive Server looks for the principal name in the environment variable SYBASE_PRINCIPAL. If neither is specified, Adaptive Server uses the server name for authentication.

Adaptive Server accepts Kerberos Open Client connections that use different server principal names if the entry for the principal name is present in the *keytab* file. To allow connections with different principal names:

- Pass an empty string as a parameter for the -k option, or
- Set the SYBASE_PRINCIPAL environment variable to "". For example:

```
export SYBASE_PRINCIPAL=""
```

Example

In this example, the Adaptive Server name is "secure_ase" and the realm name is "MYREALM.COM." The Adaptive Server name is specified on the command line with -s parameter to the dataserver. The current realm is specified in *libtcl.cfg* by a secbase attribute value:

```
[SECURITY]
csfkrb5=libskrb.so libgss=/krb5/lib/libgss.so
secbase=@MYREALM.COM
```

The default Adaptive Server principal name is "secure_ase@MYREALM.COM." If the principal name defined in the Adaptive Server *keytab* file is "aseprincipal@MYREALM.COM," you can override the default Adaptive Server principal name by setting a server principal name using options 1 or 2 below:

- Option 1, specify -k '':

  ```
  %
  $SYBASE/$SYBASE_ASE/bin/dataserver -dmaster.dat
  -s secure_ase -k aseprincipal@MYREALM.COM
  ```

  The Adaptive Server principal name used to authenticate with Kerberos is "aseprincipal@MYREALM.COM."

- Option 2, set SYBASE_PRINCIPAL:

  ```
  setenv SYBASE_PRINCIPAL aseprincipal@MYREALM.COM
  $SYBASE/$SYBASE_ASE/bin/dataserver –dmaster.dat
  -s secure_ase
  ```

  The Adaptive Server principal name used to authenticate with Kerberos is "aseprincipal@MYREALM.COM," the value of *$SYBASE_PRINCIPAL*.

- Option 3, neither -k nor SYBASE_PRINCIPAL is set:

  ```
  % $SYBASE/$SYBASE_ASE/bin/dataserver –dmaster.dat
  -s secure_ase
  ```

  The Adaptive Server principal name used to authenticate with Kerberos is "secure_ase@MYREALM.COM."

Using *sybmapname* to handle user principal names

sybmapname converts external user principal names used in the Kerberos environment to the namespace of Adaptive Server user logins. You can customize the sybmapname shared object and map names specified in the Kerberos input buffer to names suitable for a login to the Adaptive Server output buffer.

Use the sybmapname shared object to perform the custom mapping between the user principal name and the Adaptive Server login name. This shared object is optionally loaded at server start-up, and the function syb__map_name contained in the shared object is called after a successful Kerberos authentication and just before the user principal is mapped to a login in the syslogins table. This function is useful when the user principal name and the login name to be mapped are not identical.

```
syb__map_name(NAMEMAPTYPE *protocol, char *orig,
int origlen, char *mapped, int *mappedlen)
```

where:

- NAMEMAPTYPE *protocol – refers to a structure reserved for usage of this function.
- char *orig – is an input buffer that is not null-terminated.
- int origlen – is the input buffer length, which should be less than or equal to 255 characters.
- char *mapped – is an output buffer that should not be null-terminated.
- int *mappedlen – is an output buffer length, which should be less than or equal to 30.

syb__map_name returns a value greater than 0 if the mapping succeeds, or returns a value of 0 if no mapping occurred, and it returns a value less than 0 when an error occurs in syb__map_name. When an error occurs, reporting the mapping failure is written to the Adaptive Server error log.

For example, to authenticate a Kerberos user on Adaptive Server:

1. Configure Adaptive Server to use the Kerberos security mechanism. See “Using Kerberos” on page 110 and Open Client/Server documentation, and the white paper titled “Configuring Kerberos for Sybase” on the Sybase Web site at http://www.sybase.com/detail?id=1029260.

   A sample *sybmapname.c* file is located in *$SYBASE/$SYBASE_ASE/sample/server/sybmapname.c*.

2. Modify *sybmapname.c* to implement your logic. See “Precautions when using sybmapname” on page 120.

3. Build the shared object or DLL using the generic platform-specific makefile supplied. You may need to modify the makefile to suit your platform-specific settings.

4 Place the resulting shared object generated in a location specified in your $LD_LIBRARY_PATH on UNIX machines, and PATH variable on Windows machines. The file should have read and execute permissions for the "sybase" user.

Note Sybase recommends that only the "sybase" user is allowed read and execute permissions, and that all other access should be denied.

Verifying your login to Adaptive Server using Kerberos authentication

To verify your login to Adaptive Server using Kerberos authentication, assume that:

- *$SYBASE* refers to your release and installation directory.
- *$SYBASE_ASE* refers to the Adaptive Server version directory that contains your server binary.
- *$SYBASE_OCS* refers to the Open Client/Server version directory.

Example 1 If a client's principal name is `user@REALM`, and the corresponding entry in syslogins table is `user_REALM`, you can code sybmapname to accept the input string `user@realm` and to convert the input string to the output string `user_REALM`.

Example 2 If the client principal name is `user`, and the corresponding entry in syslogins table is `USER`, then sybmapname can be coded to accept the input string `user` and convert this string to uppercase string `USER`.

sybmapname is loaded by Adaptive Server at runtime and uses its logic to do the necessary mapping.

The following actions and output illustrate the sybmapname function described in Example 2. The *sybmapname.c* file containing the customized definition for syb__map_name() should be compiled and built as a shared object (or DLL), and finally placed in the appropriate path location. Start Adaptive Server with the Kerberos security mechanism enabled.

To initialize the Ticket Granted Ticket (TGT), which is a encrypted file that provides identification:

```
$ /krb5/bin/kinit johnd@public
Password for johnd@public:
$
```

To list the TGT:

```
$ /krb5/bin/klist
   Cache Type: Kerberos V5 credentials cache
   Cache Name: /krb5/tmp/cc/krb5cc_9781
```

```
Default principal: johnd@public
```

Log in as “sa” and verify the user login for “johnd”:

```
$ $SYBASE/$SYBASE_OCS/bin/isql -Usa -P
      -Ipwd`/interfaces
1>

1> sp_displaylogin johnd
2> go
No login with the specified name exists.
(return status = 1)

1> sp_displaylogin JOHND
2> go
Suid: 4
Loginame: JOHND
Fullname:
Default Database: master
Default Language:
Auto Login Script:
Configured Authorization:
Locked: NO
Password expiration interval: 0
Password expired: NO
Minimum password length: 6
Maximum failed logins: 0
Current failed login attempts:
Authenticate with: ANY
(return status = 0)
```

Successful Kerberos authentication, maps lower-case `johnd` to uppercase `JOHND` using the sybmapname utility, and allows user `johnd` to log in to Adaptive Server:

```
$ $SYBASE/$SYBASE_OCS/bin/isql -V -I'pwd'/interfaces
1>
```

Precautions when using *sybmapname*

When coding for sybmapname:

- Use caution when making modifications to the sample *sybmapname.c* program. Avoid using code that may create a segmentation fault, that may call exit, that may call system calls, that may change UNIX signals, or that makes any blocking calls. Improper coding or calls may interfere with the Adaptive Server engine.

Note Sybase bears no responsibility for coding errors in sybmapname.

- Code defensively, check all pointers before no longer referencing them, and avoid system calls. The functions you write must be quick name-filtering functions.
- Do not use goto statements since, depending on the platform, they may cause unexpected side effects.
- If you use multiple realms, use caution when mapping the user principal names to a suitable login name to reflect the realm information. For example, if you have two users whose user principal names are `userA@REALMONE` and `userB@REALMTWO`, respectively, map them to the login names `userA_REALMONE` and `userB_REALMTWO`, instead of `userA` or `userB`. This distinguishes the two users who belong to different realms.

Concurrent Kerberos authentication

Adaptive Server version 15.0.3 supports concurrent Kerberos authentication, whereas earlier versions used locking mechanisms during Kerberos authentication to protect internal data structures.

When there are concurrent logins using Kerberos authentication, Adaptive Server now establishes multiple Kerberos authentication sessions.

Version 15.0.3 also resolves an issue with concurrent login sessions, which may be blocked during Kerberos authentication. This concurrency issue occurs when you use prior versions of Adaptive Server with MIT version 1.3.x and 1.4.x Kerberos GSSAPI libraries.

Configuring Adaptive Server for LDAP user authentication

The LDAP user authentication allows client applications to send user name and password information to Adaptive Server for authentication by the LDAP server instead of syslogins. Authentication using the LDAP server allows you to use server-wide passwords instead of Adaptive Server or application-specific passwords.

LDAP user authentication is ideal if you want to simplify and centralize user administration, or want to avoid unnecessary complexities for user administration.

LDAP user authentication works with directory servers that meet Version 3 of the LDAP protocol standard, including Active Directory, iPlanet, and OpenLDAP Directory Server.

Use one of these authentication algorithms with LDAP user authentication:

- Composed DN for authentication, available for Adaptive Server version 12.5.1 or later, or,
- Searched DN for authentication, available for Adaptive Server version 12.5.2 and later.

These algorithms differ in how they obtain a user's distinguished name (DN).

The primary data structure used with the LDAP protocol is the LDAP URL.

An LDAP URL specifies a set of objects or values on an LDAP server. Adaptive Server uses LDAP URLs to specify an LDAP server and search criteria to use to authenticate login requests.

The LDAP URL uses this syntax:

```
ldapurl::=ldap://host:port/node/attributes [base | one | sub] filter
```

where:

- *host* – is the host name of the LDAP server.
- *port* – is the port number of the LDAP server.
- *node* – specifies the node in the object hierarchy at which to start the search.
- *attributes* – is a list of attributes to return in the result set. Each LDAP server may support a different list of attributes.

- base | one | sub – qualifies the search criteria. base specifies a search of the base node; one specifies a search of the base node and one sublevel below the base node; sub specifies a search of the base node and all node sublevels.
- filter – specifies the attribute or attributes to be authenticated. The filter can be simple, such as `uid=*`, or compound, such as `(uid=*)(ou=group)`.

Composed DN algorithm

This is the login sequence when you use the composed DN algorithm:

1. Open Client connects to an Adaptive Server listener port.
2. The Adaptive Server listener accepts the connection.
3. Open Client sends an internal login record.
4. Adaptive Server reads the login record..
5. Adaptive Server binds to the LDAP server with a DN composed from the primary URL and the login name from the login record. This bind also uses the password from the login record.
6. The LDAP server authenticates the user, returning either a success or failure message.
7. If the Primary URL specifies a search, then Adaptive Server sends the search request to the LDAP server.
8. The LDAP server returns the results of the search.
9. Adaptive Server accepts or rejects the login, based on the search results.

Searched DN algorithm

This is the login sequence when you use the searched DN algorithm:

1. Open Client connects to an Adaptive Server listener port.
2. The Adaptive Server listener accepts the connection.
3. Open Client sends an internal login record.
4. Adaptive Server reads the login record.

5 Adaptive Server binds to the LDAP server with a directory server access account.

   The connection established in steps 5 and 6 may persist between authentication attempts from Adaptive Server to reuse connections to DN searches.

6 The LDAP server authenticates the user, returning either a success or failure message.

7 Adaptive Server sends search requests to the LDAP server based on the login name from the login record and the DN lookup URL.

8 The LDAP server returns the results of the search.

9 Adaptive Server reads the results to obtain an a value of attribute from the DN lookup URL.

10 Adaptive Server uses the value of attribute as the DN and the password from the login record to bind to the LDAP server.

11 The LDAP server authenticates the user, returning either a success or failure message.

12 If the primary URL specifies a search, Adaptive Server sends the search request to the LDAP server.

13 The LDAP server returns the results of the search.

14 Adaptive Server accepts or rejects the login, based on the search results.

Adaptive Server reports a generic login failure to the client if any of these authentication criteria are not met.

You may skip steps 12 and 13 by not specifying search criteria in the primary or secondary URL strings. The authentication completes, displaying the success or failure returned by step 11.

Configuring LDAP

You can configure Adaptive Server for LDAP authentication and migrate existing Adaptive Servers to LDAP.

❖ Configuring LDAP in new Adaptive Server installations

1 Specify the Adaptive Server LDAP URL search strings and access account values.

2 Set enable ldap user auth to 2.

3 Add users in the LDAP directory server using LDAP vendor-supplied tools.

4 Add users to Adaptive Server using create login. You can also use sp_maplogin to automatically create login accounts upon authentication or apply other login controls.

❖ **Migrating existing Adaptive Servers to LDAP**

To avoid disruption of service in existing server installations, migrate Adaptive Server to LDAP.

1 Specify an LDAP URL search string to Adaptive Server.

2 Set the configuration parameter enable ldap user auth to 1.

3 Add users in the LDAP directory server.

4 When all users are added to the LDAP server, set enable ldap user auth to 2 to require all authentications to be performed with LDAP, or use sp_maplogin to override configuration parameters with login controls.

LDAP user authentication administration

Use sp_ldapadmin to create or list an LDAP URL search string, verify an LDAP URL search string or login, and specify the access accounts and tunable LDAP user authentication (LDAPUA) related parameters. You must have the SSO role to execute sp_ldapadmin.

See the *Reference Manual: Commands*.

Composed DN examples

If you use a simple LDAP server topology and schema, you can use a composed DN algorithm for user authentication. If you use commercially available schemas (for example, iPlanet Directory Servers or OpenLDAP Directory Servers), users are created as objects in the same container in the LDAP server tree, and Adaptive Server determines the user’s DN from the object’s location. However, there are restrictions on the LDAP server’s schema:

- You must specify the filter with the attribute name that uniquely identifies the user to be authenticated.
- You must specify the filter with the attribute `name=*`. The asterisk is a wildcard character. The appropriate attribute name to use in the filter depends on the schema used by the LDAP server.

- The Adaptive Server login name is the same as the short user name for example, a UNIX user name.
- The DN uses the short user name rather than a full name with embedded spaces or punctuation. For example, jqpublic meets the restriction for a DN, but “John Q. Public” does not.

iPlanet example

LDAP vendors may use different object names, schema, and attributes than those used in these examples. There are many possible LDAP URL search strings, and valid sites may also extend schemas locally or use them in ways that differ from each other:

- This example uses the `uid=*` filter. To compose the DN, Adaptive Server replaces the wildcard with the Adaptive Server login name to be authenticated, and appends the resulting filter to the node parameter in the LDAP URL. The resulting DN is:

```
uid=myloginname,ou=People,dc=mycomany,dc=com
```

- After a successful bind operation, Adaptive Server uses the connection to search for attribute names, such as `uid`, that are equal to the login name:

```
sp_ldapadmin set_primary_url,
'ldap://myhost:389/ou=People,dc=mycompany,dc=com??sub?uid=*'
```

- This example uses the schema defined in OpenLDAP 2.0.25, with an attribute name of `cn`.

  The composed DN is `cn=myloginname,dc=mycompany,dc=com`:

```
sp_ldapadmin set_primary_url,
'ldap://myhost:389/dc=mycompany,dc=com??sub?cn=*'
```

Searched DN examples

Use the searched DN to use an Active Directory server or other LDAP server environment that does not meet the restrictions to use the composed DN algorithm.

- Perform these steps for an Active Directory server using a commercially available user schema from a Windows 2000 Server.

  a Set the access account information:

```
sp_ldapadmin set_access_acct,
'cn=Admin Account, cn=Users, dc=mycompany, dc=com',
'Admin Account secret password'
```

  b Set the primary URL:

```
sp_ldapadmin set_primary_url, 'ldap://hostname:389/
```

  c Set the DN lookup URL search string:

```
sp_ldapadmin set_dn_lookup_url,
'ldap://hostname:389/cn=Users,dc=mycompany,dc=com?distinguishedName
?one?samaccountname=*'
```

On Windows 2000, the short name is typically referred to as the "User Logon Name" and is given the attribute name samaccountname in the default schema. This is the attribute name used to match the Adaptive Server login name. The DN for a user contains a full name with punctuation and embedded spaces (for example, `cn=John Q. Public, cn=Users, dc=mycomany, dc=com`. The DN on Windows does not use the short name, so the searched DN algorithm is appropriate for sites using the Active Directory schema (the default) as the LDAP server. The primary URL does not specify a search. Instead, it relies on the bind operation for authentication.

Examples using search filters to restrict Adaptive Server access

You can use LDAP URL search strings to restrict access to groups of users on LDAP servers. For example, to restrict logins to users in an accounting group. use a compound filter to restrict access to the group of users where attribute `group=accounting`.

- The following LDAP URL string uses the composed DN algorithm for an iPlanet server:

  ```
  sp_ldapadmin set_primary_url,
  'ldap://myhost:389/ou=People,dc=mycompany,
  dc=com??sub?(&(uid=*)(group=accounting))'
  ```

  Adaptive Server binds with DN `uid=mylogin,ou=People,dc=mycompany,dc=com`. After successfully binding with this identity, it searches for:

  ```
  "ou=People,dc=mycompany,dc=com??sub?(&(uid=mylogin)(group=accounting))"
  ```

  Authentication succeeds if this search returns any objects.

- These examples use LDAP URL strings with compound filters:

  ```
  sp_ldapadmin set_primary_url,
  'ldap://myhost:389/ou=people,dc=mycompany,dc=com??s
  ub?(&(uid=*)(ou=accounting) (l=Santa Clara))'
  ```

  ```
  sp_ldapadmin, set_primary_url,
  'ldap://myhost:389/ou=people,dc=mycompany,dc=com??s
  ub?(&(uid=*)(ou=Human%20Resources))'
  ```

LDAP user authentication password information changes

There are two LDAP user authentication-related informational messages that Adaptive Server obtains from the LDAP server and passes to the client:

- If you log in to an Adaptive Server using an LDAP authentication mechanism with an LDAP user authentication password that is about to expire, you see:

  ```
  Your password will expire in <number> days.
  ```

- If you attempt to log in to Adaptive Server using an LDAP authentication mechanism after the LDAP server administrator resets your password or after your LDAP server password has expired, you see message 4002:

  ```
  Login failed
  ```

  If auditing is enabled and the errors auditing option is turned on, message 4099 is sent to the audit log:

  ```
  Your LDAP password has expired.
  ```

Note Configure your LDAP server to give this additional information. Additionally, Adaptive Server must support the transmission of LDAP password controls to an LDAP client.

Failover support

When a major failure occurs in the LDAP directory server specified by the primary URL, and the server no longer responds to network requests, Adaptive Server attempts to connect to the secondary LDAP directory server specified by the secondary URL. Adaptive Server uses the LDAP function ldap_init to determine if it can open a connection to the LDAP directory server. A null or invalid primary URL string causes Adaptive Server to attempt to fail over to a secondary URL. Failures returned by LDAP bind or search operations do not cause Adaptive Server to fail over to the secondary URL.

Adaptive Server logins and LDAP user accounts

Once you enable LDAP user authentication, choose and set an authentication algorithm and URL strings, you must configure the user accounts. The LDAP administrator creates and maintain accounts in the LDAP server, and the database administrator creates and maintains accounts in Adaptive Server. Alternatively, the database administrator can choose administration options that allow flexibility with login accounts when integrating Adaptive Server with external authentication mechanisms such as LDAP server. The database administrator continues to administer the Adaptive Server account roles, default database, default language, and other login-specific attributes using traditional commands and procedures.

Table 4-6 describes the updates to syslogins table Adaptive Server makes at login time. These updates assume that LDAP user authentication is configured, the login is not restricted from using LDAP, and you have not set the create login mapping.

Table 4-6: Updates to syslogins from LDAP

Does the row exist in syslogins?	LDAP server authentication succeeds?	Changes in syslogins
No	Yes	No change, login fails
No	No	No change, login fails
Yes	Yes	Update row if password has changed
Yes	No	No change

Secondary lookup server support

Adaptive Server provides uninterrupted support to Adaptive Server clients that are authenticated by an LDAP server. You can specify a secondary LDAP lookup server to fail over from a primary LDAP server in the event of the LDAP server failure or planned downtime.

The health of the URL set is monitored through the following states:

- INITIAL – indicates that LDAP user authentication is not configured.
- RESET – indicates that the URL has been entered with Adaptive Server administrative commands.
- READY – indicates that the URL is ready to accept connections.
- ACTIVE – indicates that the URL has performed a successful LDAP user authentication.

- FAILED – indicates that there is a problem connecting to the LDAP server.
- SUSPENDED – indicates that the URL is in maintenance mode, and will not be used.

The following sequence of events describe the failover and manual failback:

1. The primary and secondary URL sets are configured and in a READY state.
2. The connections are authenticated using the primary server infrastructure.
3. The primary server fails, and its state is changed to FAILED.
4. Connections automatically begin authentication through the secondary server infrastructure.
5. The primary server is repaired and brought back online by an LDAP administrator. The primary LDAP server state is changed by an Adaptive Server administrator to READY.
6. New connections are authenticated using the primary server.

Note Once Adaptive Server has failed over to the secondary LDAP server, a database administrator must manually activate the primary LDAP server before it can be used again.

When Adaptive Server encounters errors connecting to an LDAP server, it retries the authentication three times. If the errors persist, the LDAP server is marked as FAILED. See "Troubleshooting LDAP user authentication errors" on page 137 for information on the LDAP errors that force Adaptive Server into a retry loop.

Use sp_ldapadmin to configure secondary lookup LDAP servers.

- To set the secondary DN lookup URL, enter:

```
sp_ldapadmin set_secondary_dn_lookup_url, <URL>
```

- To set the administrative access account for the secondary DN lookup URL, enter:

```
sp_ldapadmin set_secondary_access_acct, <DN>, <password>
```

- To suspend the use of a primary or secondary URL for authentication, enter:

```
sp_ldapadmin suspend, {primary | secondary}
```

- To activate the set of primary or secondary URLs for authentication, enter:

```
sp_ldapadmin activate, {primary | secondary}
```

- To display details about the primary and secondary LDAP server settings and status, enter:

  ```
  sp_ldapadmin list
  ```

  sp_ldapadmin list combines previous outputs from list_access_acct and list_urls. It has the following expected output for the primary and secondary servers:

  - Search URL
  - Distinguished name lookup URL
  - Access account DN
  - Active [true | false]
  - Status [ready | active | failed | suspended | reset]

Adaptive Server version 12.5.4 and later includes the following sp_ldapadmin options that support secondary servers.

- To display DN lookup URLs for the secondary server, enter:

  ```
  sp_ldapadmin list_urls
  ```

- To display the administrative account for the secondary DN lookup URL, enter:

  ```
  sp_ldapadmin list_access_acct
  ```

- To display subcommands, enter:

  ```
  sp_ldapadmin help
  ```

LDAP server state transitions

Table 4-7 – Table 4-12 list LDAP server state transitions when each sp_ldapadmin commands is executed.

Table 4-7 shows the state transitions when you execute sp_ldapadmin set_URL, where set_URL represents one of these commands:

- set_dn_lookup_url
- set_primary_url
- set_secondary_dn_lookup_url

- set_secondary_url

Table 4-7: State transitions when sp_ldapadmin set_URL is executed

Initial state	Final state
INITIAL	RESET
RESET	RESET
READY	READY
ACTIVE	RESET
FAILED	RESET
SUSPENDED	RESET

Table 4-8 shows the state transitions when you execute sp_ldapadmin suspend.

Table 4-8: State transitions when sp_ldapadmin suspend is executed

Initial state	Final state
INITIAL	Error
RESET	SUSPENDED
READY	SUSPENDED
ACTIVE	SUSPENDED
FAILED	SUSPENDED
SUSPENDED	SUSPENDED

Table 4-9 shows the state transitions when you execute sp_ldapadmin activate.

Table 4-9: State transitions when sp_ldapadmin activate is executed

Initial state	Final state
INITIAL	Error
RESET	READY
READY	READY
ACTIVE	ACTIVE
FAILED	READY
SUSPENDED	READY

The following tables show the LDAP server state transitions carried out implicitly by Adaptive Server.

Table 4-10 shows the state transitions when Adaptive Server is restarted:

Table 4-10: State transitions when Adaptive Server is restarted

Initial state	Final state
INITIAL	INITIAL
RESET	RESET

Initial state	Final state
READY	READY
ACTIVE	READY
FAILED	FAILED
SUSPENDED	SUSPENDED

Adaptive Server only attempts an LDAP login if the LDAP server is in a READY or ACTIVE state. Table 4-11 shows the state transitions:

Table 4-11: State transitions when an LDAP login succeeds

Initial state	Final state
READY	ACTIVE
ACTIVE	ACTIVE

Table 4-12 shows the state transitions when an LDAP login fails:

Table 4-12: State transitions when an LDAP login fails

Initial state	Final state
READY	FAILED
ACTIVE	FAILED

LDAP user authentication tuning

Configure and tune Adaptive Server options based on the load of incoming connections and the Adaptive Server-LDAP server infrastructure. Configure these options based on the number of simultaneous incoming requests:

- Use sp_configure to set max native threads, which indicates the number of native threads per engine.
- Use sp_ldapadmin to configure max_ldapua_native_threads, which indicates the number of LDAP user authentication native threads per engine.

Configure the set_timeout option (which indicates the LDAP server bind and search timeouts) based on the network and the health of the Adaptive Server/LDAP server infrastructure.

Configure the set_abandon_ldapua_when_full option to specify Adaptive Server behavior when incoming connections have consumed max_ldapua_native_threads:

Use these sp_ldapadmin options to configure the LDAP server for better performance:

- set_max_ldapua_desc – manages the concurrency of the LDAPUA connection requests. If you are using a distinguished name algorithm, setting set_max_ldapua_desc to a larger number expedites the LDAPUA connections Adaptive Server is processing.
- set_num_retries – sets the number of attempts. Tune this number according to the number of transient errors between Adaptive Server and the LDAP server. You can nullify transient errors by configuring the number of retries.
- set_log_interval – controls the number of messages sent to the Adaptive Server error log for diagnostic purposes. Using a low number clutters the error log may be helpful in identifying specific errors. Using a large number sends fewer messages to the error log, but does not have the same investigative value. Tune set_log_interval according to your error log size.

Adding tighter controls on login mapping

Use sp_maplogin to map users that are authenticated with LDAP or PAM to the local Adaptive Server login.

Note To map a user authenticated with Kerberos, use sybmapname instead of sp_maplogin.

Only users with sso_role can create or modify login mappings using sp_maplogin.

Adaptive Server avoids conflicts between an authentication mechanism setting for a login and a mapping that uses the login. Potential mapping conflicts are detected by the stored procedure sp_maplogin or the commands alter login, or create login.

These controls do not allow maps:

- From one Adaptive Server login name to another login name
- From an external name that already exists as a local login
- To a nonexistent login name

Additionally, when the authentication mechanism is specified with a mapping, the mechanism is checked with the authentication mechanism set in the target login.

If a target login's authentication mechanism restricts the login to use a particular authentication mechanism, then the mechanism specified with the mapping must match either that specified for the login or match the "ANY" authentication mechanism.

When sp_maplogin detects that a conflict exists, sp_maplogin fails and reports an error that identifies the conflict.

Similarly, alter login and create login check for an existing mapping that may conflict with the authenticate with option for the user login.

When alter login or create login detect a conflict, an error is reported to identify any conflicts with a login mapping.

Examples

Example 1 Maps an LDAP user to the Adaptive Server "sa" login. A company has adopted LDAP as their repository for all user accounts and has a security policy that requires LDAP authentication of all users including database administrators, "adminA" and "adminB," who may manage hundreds of Adaptive Servers. Auditing is enabled, and login events are recorded in the audit trail.

To map these administrator accounts to "sa," enter:

```
sp_maplogin LDAP, 'adminA', 'sa'
go
sp_maplogin LDAP, 'adminB', 'sa'
go
```

Require all users to authenticate using LDAP authentication:

```
sp_configure 'enable ldap user auth', 2
go
```

When "adminA" authenticates during login to Adaptive Server, the distinguished name associated with "adminA" rather than only "sa" is recorded in the login audit event. This allows each individual performing an action to be identified in the audit trail.

Because the "adminA" and "adminB" password is set in the LDAP server, there is no need to maintain the "sa" password on all Adaptive Servers being managed.

This example also allows different external identities and passwords to be used for authentication, while their actions within Adaptive Server still require the special privileges associated with "sa" account.

Example 2 Uses both PAM and LDAP to map users to application logins. A company has adopted both PAM and LDAP authentication but for different purposes. The company security policy defines LDAP as the authentication mechanism for general user accounts, and PAM for special users, such as for a middle-tier application. A middle-tier application may establish a pool of connections to Adaptive Server to handle requests on behalf of users of the middle-tier application.

Configure Adaptive Server for both LDAP and PAM user authentication:

```
sp_configure 'enable ldap user auth', 2
go
sp_configure 'enable pam user auth', 2
go
```

Establish an Adaptive Server login `appX` locally with permissions that are appropriate for the middle-tier application:

```
create login appX with password myPassword
go
alter login appX authenticate with PAM
go
```

Instead of hard-coding a simple password in “appX” and maintaining the password consistently in several different Adaptive Servers, develop a custom PAM module to authenticate the application in a centralized repository using additional facts to verify the middle-tier application.

Client application login “appY” requires LDAP authentication of the user with its LDAP identity and password. Use sp_maplogin to map all LDAP authenticated users to login “appY,”

```
create login appY with password myPassword
go
sp_maplogin LDAP, NULL, 'appY'
go
```

Users of “appY” are authenticated with their company identity and password, then mapped to a local Adaptive Server login “appY” to execute database actions. Authentication has occurred with the identity of the LDAP user, which is recorded in the audit trail, and executes with permissions appropriate to the application login “appY.”

Login mapping of external authentication

When you configure an external authentication mechanism, if there is a single mapping of an external user to an internal Adaptive Server login, and if the mapping is successfully authenticated, Adaptive Server updates the internal login password to match the external user's password. For example:

1. A user has an Adaptive Server login name of user_ase (with password user_password), and an LDAP login name of user_ldap (with password user_ldappasswd).

   The produces a one to one mapping for user_ldap to user_ase.

2. When user_ldap logs into Adaptive Server using the user_ldappassword, Adaptive Server updates the password for user_ase to user_ldappassword

The benefit of mapping the Adaptive Server login name to the LDAP password is that the user can log in with the most recently used LDAP password if the LDAP server crashes. That is, when a user has a one-to-one mapping of a user name to an LDAP password for Adaptive Server authentication, the user appears to have uninterrupted authentication to Adaptive Server because the password is updated locally when it is used to authenticate the login.

However, Adaptive Server does not update the password locally when more than one external user is mapped to the local user. If the LDAP server crashes, Adaptive Server cannot authenticate multiple external users mapped to a single Adaptive Server user.

Troubleshooting LDAP user authentication errors

Adaptive Server may experience the following transient errors when communicating with the LDAP server. These errors are generally resolved by retrying the connection. If the errors persist after three retry attempts, Adaptive Server marks the LDAP server as FAILED.

- LDAP_BUSY – server is busy.
- LDAP_CONNECT_ERROR – error during a connection.
- LDAP_LOCAL_ERROR – error on the client side.
- LDAP_NO_MEMORY – cannot allocate memory on the client side.
- LDAP_OPERATIONS_ERROR – error on the server side.
- LDAP_OTHER – unknown error code.
- LDAP_ADMINLIMIT_EXCEEDED – a search has exceeded a limit.

- LDAP_UNAVAILABLE – server cannot process the request.
- LDAP_UNWILLING_TO_PERFORM – server is not going to process the request.
- LDAP_LOOP_DETECT – a loop has been detected during a referral.
- LDAP_SERVER_DOWN – server is not reachable (connection fails).
- LDAP_TIMEOUT – LDAP API fails because operation does not complete in the user-specified amount of time.

Transient errors and a large number of simultaneous login requests may lead to a large number of repeated error messages in the error log. To increase the readability of the log, this error message logging algorithm is used:

1. If a message is being logged for the first time, log it.
2. If the last time the message was logged was greater than 3 minutes:
   - Log the error message.
   - Log the number of times the message was repeated since the message was last printed.
   - Log the time elapsed, in minutes, since the message was printed.

Authentication failures arising from the following are not considered LDAP errors and are not conditions for retrying the authentication request:

- Bind failure due to bad password or an invalid distinguished name.
- A search after a successful bind that returns a result set of 0 or no attribute value.

Syntax errors found while parsing the URL are caught when an LDAP URL is set, and therefore do not fall into any of the above categories.

Configuring an LDAP server

User authentication for Lightweight Directory Access Protocol (LDAP) supports the Secure Sockets Layer/Transport Layer Security (SSL/TLS) protocol, providing secure data transmission between Adaptive Server and an LDAP server.

❖ Configure a connection to an LDAP server

1. Make sure that all trusted root certificates are located in the same file.

After you define the trusted servers, Adaptive Server configures a secure connection, where *servername* is the name of the current Adaptive Server. If you:

- Have defined *$SYBASE_CERTDIR*, Adaptive Server loads certificates from *$SYBASE_CERTDIR/servername.txt* (for UNIX) or *%SYBASE_CERTDIR%\servername.txt* (for Windows).
- Have not defined *$SYBASE_CERTDIR*, Adaptive Server loads certificates from *$SYBASE/$SYBASE_ASE/certificates/servername.txt* (for UNIX) or *%SYBASE%\%SYBASE_ASE%\certificates\servername.txt* (for Windows).

2 Restart Adaptive Server to change the trusted root certificate file.

3 Use sp_ldapadmin, specifying *ldaps://* URLs instead of *ldap://* URLs, to establish a secure connection to a secure port of the LDAP server.

4 Establish a TLS session over a plain TCP connection:

sp_ldapadmin 'starttls_on_primary', {*true* | *false*}

or

sp_ldapadmin 'starttls_on_secondary', {*true* | *false*}

Note LDAP server connections do not have a connect timeout option; if the LDAP server stops responding, all login connections also stop responding.

LDAPS user authentication enhancements

In earlier versions of Adaptive Server, if you modify the Certifying Authority (CA) trusted root file, you must restart Adaptive Server for the modifications to take effect. Adaptive Server version 15.0.3 and later supports modifications to the trusted root file, so that restarting the the server is unnecessary. A new subcommand, reinit_descriptors, which unbinds the LDAP server descriptors and reinitializes the user authentication subsystem. For the syntax of this option see *Reference Manual: Procedures*.

- This command requires System Security Officer permissions.

- If the trusted root file is modified without execution of this command by a user with System Security Officer permissions, the housekeeping utility chores task uses a new chore, designed to reinitialize the user authentication subsystem every 60 minutes.

Automatic LDAP user authentication and failback

Adaptive Server 15.0.3 provides support for a secondary LDAP server. Previously, after bringing a failed primary LDAP server online, it was necessary to activate the LDAP server manually, in order to authenticate new LDAP logins and move them to the primary LDAP server.

In versions 15.0.3 and later, a new chore has been added to Adaptive Server's housekeeping utility to activate an LDAP server automatically: 'set_failback_interval' – for syntax, see "Setting the LDAP failback time interval" on page 141.

'The set_failback_interval option in sp_ldapadmin set_failback_interval sets the interval between attempts to activate failed LDAP servers; if you do not set this parameter, the default value is 15 minutes. See sp_ldapadmin in the *Reference Manual: Procedures*.

If the primary URL is marked FAILED, the housekeeper task attempts to activate it, using the primary access account distinguished name (DN) and password. If you have not configured a primary access account, the housekeeper task attempts to use an anonymous bind. If the bind operation fails on the first attempt, the housekeeper task retries the bind operation for the number of retry times configured. If the bind operation succeeds, the primary URL is marked READY.

If the secondary URL is marked FAILED, the housekeeper task attempts to activate the secondary URL in a similar way.

The reinit_descriptors option in sp_ldapadmin executes when the certificate file is modified, in which case it reinitializes the LDAP user authentication subsystem every 60 minutes.

After you set the failback interval, the housekeeper task checks for failed LDAP servers each time it sweeps through its chores. When it finds a failed LDAP server, it attempts to activate the LDAP server when the failback time interval expires.

Setting the LDAP failback time interval

The syntax for sp_ldapadmin set_failback_interval is the following, where *time_in_minutes* is the value from -1 to 1440 minutes (24 hours):

sp_ldapadmin 'set_failback_interval', *time_in_minutes*

- A value of 0 indicates that failing back is manual. That is, the housekeeper task does not attempt to automatically fails back the LDAP server. You must perform this task manually.
- A value of -1 sets the fail over time interval to 15 minutes, the default.
- If you issue sp_ldapadmin 'set_failback_interval' without any parameters, sp_ldapadmin displays the value to which the fail back interval is set.
- If you issue sp_ldapadmin without any parameters, sp_ldapadmin includes the failback time interval in the output:

```
 sp_ldapadmin
----------------
Primary:
    URL:                    ''
    DN Lookup URL:          ''
    Access Account:         ''
    Active:                 'FALSE'
    Status:                 'NOT SET
    StartTLS on Primary LDAP URL: 'TRUE'
Secondary:
    URL:                    ''
    DN Lookup URL:          ''
    Access Account:         ''
    Active:                 'FALSE'
    Status:                 'NOT SET'
    StartTLS on Secondary LDAP URL: 'FALSE'
Timeout value:              '-1'(10000) milliseconds
Log interval:               '3' minutes
Number of retries:          '3'
Maximum LDAPUA native threads per Engine: '49'
Maximum LDAPUA descriptors per Engine: '20'
Abandon LDAP user authentication when full: 'false'
Failback interval:          '-1'(15) minutes
(return status = 0)
```

Examples

This example sets the LDAP failback time interval to 60 minutes:

```
sp_ldapadmin 'set_failback_interval' 60
```

This example sets the LDAP failback

time interval to the default, 15 minutes:

```
sp_ldapadmin 'set_failback_interval' -1
```

This example displays the value to which the failback interval is set:

```
sp_ldapadmin 'set_failback_interval'

The LDAP property 'set_failback_interval' is set to '15
    minutes'.
```

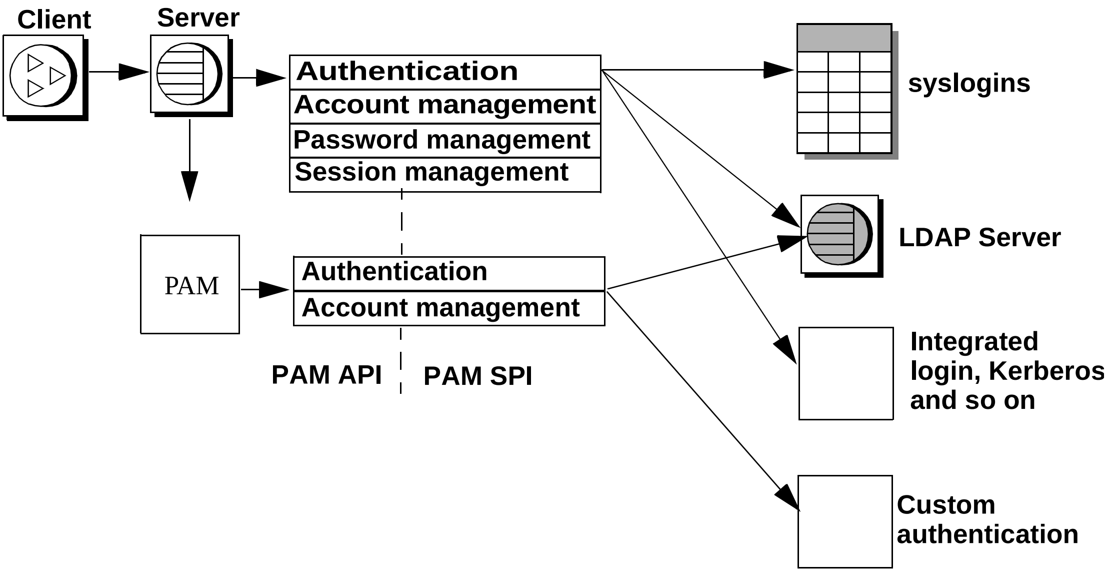
Configuring Adaptive Server for authentication using PAM

Pluggable Authentication Module (PAM) support allows multiple authentication service modules to be stacked and made available without modifying the applications that require authentication.

PAM integrates Adaptive Server with Solaris and Linux operating systems and simplifies the management and administration of user accounts and authentication mechanisms, thus reducing the total cost of ownership. Users can customize or write their own authentication and authorization modules.

Note PAM support is currently available on Linux and on Solaris platforms. For more information on PAM user authentication, see your operating system documentation.

Figure 4-2: PAM architecture



Adaptive Server passes the login name and credentials obtained from the login packet to the PAM API. PAM loads a service provider module as specified in the operating system configuration files and calls appropriate functions to complete the authentication process.

Enabling PAM in Adaptive Server

Both Linux and Solaris have predefined PAM modules. You can use one of these modules, or create one of your own. When creating your own modules, follow the guidelines in your operating system documentation on creating a PAM module.

Note PAM modules you create should comply with RFC 86.0 “Unified Login With Pluggable Authentication Modules (PAM).” Adaptive Server supports the authentication management module of the RFC. It does not support the account management, session management, or password management modules.

Configuring operating system s

To enable PAM support, configure your operating system as follows:

- For Solaris, add the following line to */etc/pam.conf*:

```
ase auth required /user/lib/security/$ISA/pam_unix.so.1
```

- For Linux, create a new file called */etc/pam.d/ase*, and add:

```
auth requried /lib/security/pam_unix.so
```

For more information on how to create these entries, see your operating system documentation.

Running a 32- and 64-bit server on the same machine

$ISA is an environment variable that allows 32- and 64-bit libraries to run together.

On Solaris 32-bit machines, $ISA is replaced by an empty string, while on 64-bit machines, it is replaced by the string “sparcv9”.

To use both 32- and 64-bit servers, place the 32-bit PAM module in a directory, and place the 64-bit version in a subdirectory of this directory.

The entry in *pam.conf* should look similar to:

```
$ ls /usr/lib/security/pam_sec.so.1
pam_sec.so.1 -> /SYBASE/pam_whatever_32bits.so.1

$ ls /usr/lib/security/sparcv9/pam_sec.so.1
pam_sec.so.1 -> /SYBASE/pam_sec_64bits.so.1

ase   auth   required
/usr/lib/security/$ISA/pam_sec.so.1
```

Note $ISA is the only variable allowed in *pam.conf*.

Configuring Adaptive Server for PAM user authentication

enable pam user auth enables PAM user authentication support:

```
sp_configure "enable pam user auth", 0 | 1 | 2
```

where:

- 0 – disables PAM authentication. This is the default.

- 1 – indicates Adaptive Server first attempts PAM authentication, and then uses syslogins authentication if PAM authentication fails.
- 2 – indicates only PAM authentication may be used.

Note When PAM is enabled, password management is delegated to the PAM service providers.

Adaptive Server logins and PAM user accounts

After you have set enable PAM user authentication and completed the PAM configuration for both Adaptive Server and the operating system, you must configure the user accounts. The operating system or network security administrator creates and maintains user accounts in the PAM service provider, and the database administrator creates and maintains accounts in Adaptive Server. Alternatively, the database administrator can choose administration options that allow flexibility with login accounts when integrating Adaptive Server with external authentication mechanisms such as PAM. The database administrator continues to administer the Adaptive Server account roles, default database, default language, and other login-specific attributes using traditional commands and procedures.

Table 4-13 describes updates to syslogins made at login time. It assumes that\

PAM user authentication is configured, the login is not restricted from using PAM, and you have not set the create login mapping.

Table 4-13: Updates to syslogins from PAM

Does the row exist in syslogins?	PAM authentication succeeds?	Changes in syslogins
No	Yes	No change, login fails
No	No	No change, login fails
Yes	Yes	Update row if password has changed
Yes	No	No change

Enhanced login controls

Configure Adaptive Server to allow the server-wide authentication mechanism according to the methods discussed in the LDAP and PAM sections earlier. You can also configure Adaptive Server to specify the authentication mechanism for each individual login on the server using Adaptive Server enhanced login controls described below.

Login-specific controls may be useful when a server is transitioning between authentication mechanisms or for server-specific logins that local server administration may require: they are not associated with a centrally managed user login.

Forcing authentication

You can force a login to use a specific authentication process by using these parameters for alter login and create login:

- ASE – use Adaptive Server internal authentication using passwords from syslogins table.
- LDAP – use external authentication with an LDAP server.
- PAM – use external authentication with PAM.
- ANY – by default, users are authenticated using this authentication method. A user with ANY authentication means that Adaptive Server checks if there is any external authentication mechanism defined, and if there is, it is used. Otherwise, it uses Adaptive Server authentication.

Adaptive Server checks for external authentication mechanisms in the following order:

1 LDAP.

2 Pluggable Authentication Modules (PAM). If both LDAP and PAM are enabled, PAM authentication is never attempted for a user.

3 If neither PAM nor LDAP is enabled, Adaptive Server uses syslogins to authenticate the login.

Login accounts such as “sa” continue to be validated using the syslogins catalog. Only the SSO role can set authenticate for a login.

For example, the following authenticates the login with alter login:

```
alter login nightlyjob modify authenticate with ASE
sp_displaylogin "nightlyjob"
```

Displays output similar to:

```
Suid: 1234
Loginname: nightlyjob
Fullname: Batch Login
Default Database: master
. . .
Date of Last Password Change: Oct 2 2003 7:38 PM
Password expiration interval: 0
Password expired: N
Minimum password length:
Maximum failed logins: 0
Current failed login attempts:
Authenticate with: ASE
```

Mapping logins using *sp_maplogin*

Use sp_maplogin to map logins:

sp_maplogin (authentication_mech | null),
(*client_username* | null), (*action* | *login_name* | null)

where:

- authentication_mech – is one of the valid values specified for the authenticate with option in sp_maplogin.
- *client_username* – is an external user name, which can be an operating system name, a user name for an LDAP server, or anything else the PAM library understands. A null value indicates that any login name is valid.
- *action* – indicates create login or drop. When you use create login, the login is created as soon as is authenticated. Use drop to remove logins.

- *login_name* is an Adaptive Server login that already exists in syslogins.

This example maps external user “jsmith” to the Adaptive Server user “guest.” Once authenticated, “jsmith” has the privileges of “guest.” The audit login record shows both the *client_username* and the Adaptive Server user name:

```
sp_maplogin NULL, "jsmith", "guest"
```

This example tells Adaptive Server to create a new login for all external users authenticated with LDAP, if a login does not already exist:

```
sp_maplogin LDAP, NULL, "create login"
```

Displaying mapping information

sp_helpmaplogin displays mapping information:

sp_helpmaplogin [(authentication_mech | null), (client_username | null)]

where:

- *client_username* – is an external user name.

If you do not include any parameters, sp_helpmaplogin displays login information about all users currently logged in to Adaptive Server. You can restrict the output to specific sets of client user names or authentication mechanists by using the parameters listed above.

This displays information about all logins:

```
sp_helpmaplogin

authentication   client name   login name
--------------   -----------   ------------------
NULL             jsmith        guest
LDAP             NULL          create login
```

Determining the authentication mechanism

Use the *@@authmech* global variable to determine the authentication mechanism Adaptive Server uses.

For example, if Adaptive Server is enabled for LDAP user authentication with failover (enable ldap user auth = 2) and user “Joe” is an external user with authentication set to ANY, when Joe logs in, Adaptive Server attempts to authenticate Joe, using LDAP user authentication. If Joe fails authentication as a user in LDAP, Adaptive Server authenticates Joe using Adaptive Server authentication, and if that succeeds, he logs in successfully.

@@authmech global has this value:

```
select @@authmech
----------------------------------
ase
```

If Adaptive Server is configured for strict LDAP user authentication (enable ldap user auth = 2) and Joe is added as a valid user in LDAP, when Joe logs in, the value for @@authmech is:

```
select @@authmech
----------------------------------
ldap
```

CHAPTER 5

Managing Roles

This chapter includes information about using roles in Adaptive Server.

Creating and assigning roles to users

Roles are collections of privileges that allow the role assignee to perform their job. The roles supported by Adaptive Server let you enforce individual accountability. Adaptive Server provides system roles, such as system administrator and system security officer, and user-defined roles, which are created and granted to users, login profiles, or other roles by a system security officer. Object owners can grant database access as appropriate to a role.

The final steps in adding database users are assigning them special roles, as required, and granting permissions. For more information on permissions, see Chapter 6, “Managing User Permissions.”

System-defined roles

Table 5-1 lists the system roles, the value to use for the *role_granted* option of the grant role or revoke role command, and the tasks usually performed by a person with that role.

Note Each role is described in detail in the following sections.

Table 5-1: System roles and related tasks

Role	Value for *role_granted*	Description
System administrator	sa_role	Manage and maintain Adaptive Server databases and disk storage
System security officer	sso_role	Perform security-related tasks
Operator	oper_role	Back up and load databases server-wide
Sybase Technical Support	sybase_ts_role	Analysis and repair of database structures
Replication	replication_role	Replicate user data
Distributed transaction manager	dtm_tm_role	Coordinate transactions across servers
High availability	ha_role	Administer and execute failover
Monitor and diagnosis	mon_role	Administer and execute performance and diagnostic monitoring
Job Scheduler administration	js_admin_role	Administer Job Scheduler
Job Scheduler user	js_user_role, js_client_role	Create and run jobs through Job Scheduler
Real-time messaging	messaging_role	Administer and executer real-time messaging
Web Services	webservices_role	Administer Web services
Key custodian	keycustodian_role	Create and manage encryption keys

Note sa_role is grantable by a user who has sa_role. All other system role are grantable by a user with sso_role. If a user defined role has been granted both sa_role and other system roles, that role may be granted only by a user who has both sa_role and sso_role.

System administrator privileges

System administrators:

- Handle tasks that are not application-specific
- Work outside the Adaptive Server discretionary access control system

The role of system administrator is usually granted to individual Adaptive Server logins. All actions taken by that user can be traced to his or her individual server user ID. If the server administration tasks at your site are performed by a single individual, you may instead choose to use the “sa” account that is installed with Adaptive Server. At installation, the “sa” account user can assume the system administrator, system security officer, and operator roles. Any user who knows the “sa” password can log in to that account and assume any or all of these roles.

Having a system administrator operate outside the protection system serves as a safety precaution. For example, if the database owner accidentally deletes all the entries in the sysusers table, the system administrator can restore the table (as long as backups exist). There are several commands that can be issued only by a system administrator. They include disk init, disk refit, disk reinit, shutdown, kill, disk mirror , mount, unmount and several monitoring commands.

In granting permissions, a system administrator is treated as the object owner. If a system administrator grants permission on another user's object, the owner's name appears as the grantor in sysprotects and in sp_helprotect output.

System administrators automatically assume the identity of a database owner when they log in to a database, and assume all database owner privileges. This automatic mapping occurs, regardless of any aliases assigned to the user. The system administrator can perform tasks usually reserved for the database owner such as dbcc commands, diagnostic functions, reading data pages, and recovering data, or indexes.

System security officer privileges

System security officers perform security-sensitive tasks in Adaptive Server, including:

- Granting the system security officer, operator, and key custodian roles
- Administering the audit system
- Changing passwords
- Adding new logins
- Dropping logins
- Locking and unlocking login accounts
- Creating and granting user-defined roles
- Administering network-based security
- Granting permission to use the set proxy or set session authorization commands
- Creating login profiles
- Managing encryption

The system security officer can access any database—to enable auditing —but, in general, has no special permissions on database objects (except for encryption keys and decrypt permission on encrypted columns. See the *Users Guide for Encrypted Columns*). An exception is the sybsecurity database, where only a system security officer can access the sysaudits table. There are also several system procedures that can be executed only by a system security officer.

System security officers can repair any changes inadvertently done to the protection system by a user. For example, if a database owner forgets the password, a system security officer can change the password to allow the database owner to log in.

The system security officers share login management responsibilities with system administrators. System security officers are responsible for managing logins and login profiles.

System security officers can can grant all system roles except sa_role. They can also create and grant user-defined roles to users, other roles, login profiles, or groups. See “Creating and assigning roles to users” on page 151.

Operator privileges

Users who have been granted the operator role can back up and restore databases on a server-wide basis without having to be the owner of each database. The operator role allows a user to use these commands on any database:

- dump database
- dump transaction
- load database
- load transaction
- checkpoint
- online database

Sybase Technical Support

A Sybase Technical Support engineer can use the Technical Support role to display internal memory and on-disk data structures using trace output, consistency checking, and patching data structures. This role is used for analyzing problems and manually recovering data. Some actions necessary for resolving these issues may require additional system roles for access. Sybase recommends that the system security officer grant this role to a knowledgeable Sybase engineer only while this analysis or repair is being done.

Replication role

The user maintaining Replication Server and ASE Replicator requires the replication role. See the *Replication Server Administration Guide* and the *ASE Replicator Users Guide* for information about this role.

Distributed Transaction Manager role

The distributed transaction manager (DTM) transaction coordinator uses this role to allow system stored procedures to administer transactions across servers. Clients using the DTM XA interface require this role. See *Using Adaptive Server Distributed Transaction Management Features*.

High availability role

You must have the high availability role to configure the high availability subsystem to administer primary and companion servers through commands and stored procedures. See *Using Sybase Failover in a High Availability System*.

Monitoring and diagnosis

This role is required to administer the Adaptive Server monitoring tables. You must have this role to execute a monitoring table remote procedure call and to administer the collection of monitored data. See the *Performance and Tuning Series: Monitoring Tables*.

Job Scheduler roles

The Job Scheduler has three system roles to manage permissions for its operation:

- js_admin_role – required to administer Job Scheduler, and provides access to the stored procedures and allow you to modify, delete, and perform Job Scheduler administrative operations.
- js_user_role – required for a user to create, modify, delete, and run scheduled jobs using the Job Scheduler stored procedures.
- js_client_role – allows users to work with predefined jobs but not to create or alter jobs.

See the *Job Scheduler Users Guide* for more information.

Real-time messaging role

Used by the real-time messaging subsystem (RTMS) execute msgsend, msgrecv, and certain sp_msgadmin commands. See the *Messaging Services User's Guide* for more information.

Web Services role

Used by the Web services subsystem to execute create service, create existing service, drop service, and alter service commands. See the *Web Services Users Guide*.

Key custodian role

The key custodian role is responsible for key management: creating and altering encryption keys, setting up the system encryption password, setting up key copies for users, and so on. See the *Encrypted Columns Users Guide*.

Planning user-defined roles

Before you implement user-defined roles, decide:

- The roles you want to create

- The responsibilities for each role
- The position of each in the role hierarchy
- Which roles in the hierarchy are mutually exclusive and if so, at the membership or activation level

Avoid name conflicts when you create user-defined roles by following a naming convention. For example, you can use the "_role" suffix for role names. Adaptive Server does not check for such restrictions.

The names of user-defined roles granted directly to users or to login profiles cannot duplicate the name of any login or login profile. If a role must have the same name as a user, avoid conflict by creating a new role, having it contain the original role, and then granting the new role to the user.

After you have planned the roles to create and the relationships among them, decide how to allocate roles according to business requirements and the responsibilities of your users.

The maximum number of roles that a user can activate per user session is 127.

The maximum number of user-defined roles that can be created server-wide is 992.

Creating a user-defined role

A user with sso_role uses the create role command to create a role. See create role in the the *Reference Manual: Commands*.

The create role command can only be used in the master database.

If a password is used, any user activating the role must specify the password. Roles with passwords cannot be used if the role is to be activated during login as the login's default role or as an automatically activated role granted to a login profile.

For example, to create the intern_role without a password, enter:

```
create role intern_role
```

To create the doctor_role and assign the password "physician", enter:

```
create role doctor_role with passwd "physician"
```

Only the system security officer can create user-defined roles.

Adding and removing passwords from a role

Only a system security officer can add or drop a password from a role.

Use the alter role command to add or drop a password from either a system or user-defined role:

alter role *role_name*
[add passwd *password* | drop passwd]

For example, to require the password "oper8x" for the oper_role, enter:

```
alter role oper_role add passwd oper8x
```

To drop the password from the role, enter:

```
alter role oper_role drop passwd
```

Note When you assign a password to a role, any user granted the role must specify the password to Adaptive Server at the time of activating the role.

Role hierarchies and mutual exclusivity

A system security officer can define role hierarchies such that if a user has one role, the user also has roles lower in the hierarchy. When you grant a role, role1, to another role, say, role2, you set up a hierarchy where role2 contains role1. For example, the "chief_financial_officer" role might contain both the "financial_analyst" and the "salary_administrator" roles.

The chief financial officer can perform all tasks and see all data that can be viewed by salary administrators and financial analysts.

Additionally, you can define a role's mutual exclusivity to enforce static or dynamic separation of duty policies. Roles can be defined to be mutually exclusive for:

- Membership – one user cannot be granted two different roles. For example, you might not want the "payment_requestor" and "payment_approver" roles to be granted to the same user.
- Activation – one user cannot activate, or enable, two different roles. For example, a user might be granted both the "senior_auditor" and the "equipment_buyer" roles, but not permitted to have both roles enabled at the same time.

System roles, as well as user-defined roles, can be defined to be in a role hierarchy, or to be mutually exclusive. For example, you might want a "super_user" role to contain the system administrator, operator, and Technical Support roles. To enforce a separation of roles, you may want to define the system administrator and system security officer roles to be mutually exclusive for membership; that is, one user cannot be granted both roles.

Defining and changing mutual exclusivity of roles

To define mutual exclusivity between two roles, use:

alter role *role1* { add | drop } exclusive { membership | activation } *role2*

For example, to define intern_role and specialist_role as mutually exclusive at the membership level, enter:

```
alter role intern_role add exclusive membership
specialist_role
```

The example above restricts users who have membership in intern_role from also being members of specialist_role.

To define the sso_role and sa_role as mutually exclusive at the activation level, enter the following command, which prohibits a user who is a member of sso_role and sa_role from assuming both roles simultaneously:

```
alter role sso_role add exclusive activation sa_role
```

Defining and changing a role hierarchy

Defining a role hierarchy involves choosing the type of hierarchy and the roles, then implementing the hierarchy by granting roles to other roles.

For example:

```
grant role intern_role to specialist_role
grant role doctor_role to specialist_role
```

This grants to "specialist" all the privileges of both "doctor" and "intern."

To establish a hierarchy with a "super_user" role containing the sa_role and oper_role system roles, specify:

```
grant role sa_role to super_user
```

```
grant role oper_role to super_user
```

Note If a role requires a password to be contained within another role, the user with the role that contains the other does not need to use the password for the contained role. In the example above, assume that the “doctor” role usually requires a password. The user who has the “specialist” role does not need to enter the “doctor” password because “doctor” is contained within “specialist.” Role passwords are only required for the highest level role.

When creating role hierarchies:

- You cannot grant a role to another role that directly contains it. This prevents duplication.

  In the example above, you cannot grant “doctor” to “specialist” because “specialist” already contains “doctor.”

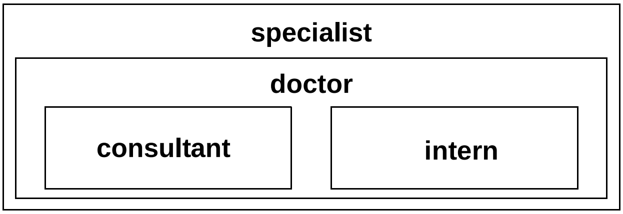
- You can grant a role to another role that does not directly contain it.

  For example, in Figure 5-1, you can grant the “intern” role to the “specialist” role, even though “specialist” already contains the “doctor” role, which contains “intern.” If you subsequently dropped “doctor” from “specialist,” then “specialist” still contains “intern.”

  In Figure 5-1, “doctor” has “consultant” role permissions because “consultant” has been granted to “doctor.” The “specialist” role also has “consultant” role permissions because “specialist” contains the “doctor” role, which in turn contains the “consultant.”

  However, “intern” does not have “consultant” role privileges, because “intern” does not contain the “consultant” role, either directly or indirectly.

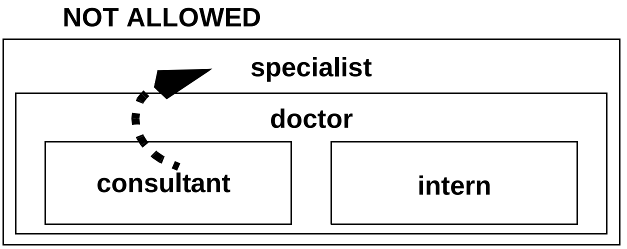
Figure 5-1: Explicitly and implicitly granted privileges



- You cannot grant a role to another role that is contained by the first role. This prevents “loops” within the hierarchy.

  For example, in Figure 5-2, you cannot grant the “specialist” role to the “consultant” role; “consultant” is already contained in “specialist.”

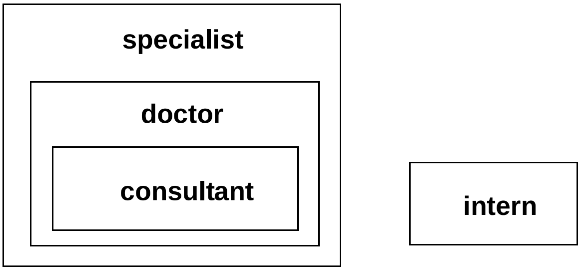
Figure 5-2: Granting a role to a role contained by grantor



- When the system security officer grants to a user a role that contains other roles, the user implicitly gets membership in all roles contained by the granted role. However, a role can be activated or deactivated directly only if the user has explicit membership in that role.
- The system security officer cannot grant one role to another role that is explicitly or implicitly mutually exclusive at the membership level with the first role.

  For example, in Figure 5-3, if the “intern” role is defined as mutually exclusive at the membership level with the “consultant” role, the system security officer cannot grant “intern” to the “doctor.”

Figure 5-3: Mutual exclusivity at membership



- The user can activate or deactivate only directly granted roles.

  For example, in the hierarchy shown in Figure 5-3, assume that you have been granted the “specialist” role. You have all the permissions of the “specialist” role, and, implicitly, because of the hierarchy, you have all the permissions of the “doctor” and “consultant” roles. However, you can activate only the “specialist” role. You cannot activate “doctor” or “consultant” because they were not directly granted to you. See “Activating and deactivating roles” on page 163.

Revoking roles from other roles is similar to granting roles to other roles. It removes a containment relationship, and the containment relationship must be a direct one.

For example:

- If the system security officer revokes the “doctor” role from “specialist,” “specialist” no longer contains the “consultant” role or the “intern” role.
- The system security officer cannot revoke the “intern” role from “specialist” because “intern” is not directly contained by “specialist.”

Setting up default activation at login

A system security officer can change role activation using alter login or alter login profile.

When a user logs in to Adaptive Server, the user’s roles are not necessarily active, depending upon how the role is set up as a default role. If a role has a password associated with it, the user must use the set role command to activate the role.

The system security officer determines whether to activate roles granted by default at login and uses the auto activated roles attribute of alter login profile or alter login to set the default status of user roles individually for each user. Individual users can change only their own default setttings. auto activated roles only affects user roles, not system roles.

By default, user-defined roles that are granted are not activated at login, but system roles that are granted are automatically activated, if they do not have passwords associated with them.

The following example shows how to automatically activate roles on login if they are not password protected.

```
alter login mgr add auto activated roles
mgr_role, eng_role
```

The following example shows how to use the login profile to automatically activate roles on login if they are non password protected. The mgr_role and eng_role must be granted to mgr_lp:

```
alter login profile mgr_lp add auto activated roles
mgr_role, eng_role
```

Dropping user-defined roles

As system security officer, drop a role using :

drop role *role_name* [with override]

where *role_name* is the name of a user-defined role.

with override revokes all access privileges granted to the role in every database on the server.

If you do not use with the override option, you must revoke all privileges granted to the role in all databases before you can drop the role. If you do not, the command fails. To revoke privileges, use the revoke command

You need not drop memberships before dropping a role. Dropping a role automatically removes any user's membership in that role, regardless of whether you use the with override option.

Activating and deactivating roles

Roles must be active to have access privileges (that is, inactive roles do not have privileges). A default role cannot be active at login. Roles with passwords are always inactive at login.

To activate or deactivate a role:

set role *role_name* [with passwd "*password*"] {on | off}

Include the with passwd parameter only if you are activating role. See the *Reference Manual: Commands*.

For example, to activate the "financial_analyst" role with the password "sailing19", enter:

```
set role financial_analyst with passwd "sailing19" on
```

Activate roles only when you need them, and deactivate them when the roles are no longer necessary. Keep in mind that, when the sa_role is active, you assume the identity of database owner within any database that you use.

Displaying information about roles

Table 5-2 lists the system procedures and functions to use to find information about roles.

Table 5-2: Finding information about roles

To display information about	Use	See
The role ID of a role name	role_id system function	"Finding role IDs and names" on page 164
The role name of a role ID	role_name system function	"Finding role IDs and names" on page 164
System roles	show_role system function	"Viewing active system roles" on page 164
Role hierarchies and roles that have been granted to a user or users	sp_displayroles system procedure	"Displaying a role hierarchy" on page 165
Whether one role contains another role in a role hierarchy	role_contain system function	"Viewing user roles in a hierarchy" on page 165
Whether two roles are mutually exclusive	mut_excl_roles system function	"Determining mutual exclusivity" on page 165
Roles that are active for the current session	sp_activeroles system procedure	"Determining role activation" on page 166
Whether you have activated the correct role to execute a procedure	has_role system function	"Checking for roles in stored procedures" on page 166
Logins, including roles that have been granted	sp_displaylogin system procedure	"Getting information about login accounts" on page 76
Permissions for a user, group, or role	sp_helprotect system procedure	"Reporting on permissions" on page 202

Finding role IDs and names

To find a role ID when you know the role name, use:

role_id(*role_name*)

Any user can execute role_id. If the role is valid, role_id returns the server-wide ID of the role (srid). The syssrvroles system table contains an srid column with the role ID and a name column with the role name. If the role is invalid, role_id returns NULL.

To find a role name when you know the role ID, use: role_name:

role_name(*role_id*)

Any user can execute role_name.

Viewing active system roles

Use show_role to display the currently active system roles for the specified login:

```
show_role()
```

If you have not activated any system role, show_role returns NULL. If you are a database owner, and you execute show_role after using setuser to impersonate another user, show_role returns your own active system roles, not those for whom you are impersonating.

Any user can execute show_role.

Note The show_role function does not include information about user-defined roles.

Displaying a role hierarchy

You can use sp_displayroles to see all roles granted to your login name or see the entire hierarchy tree of roles displayed in table format:

sp_displayroles {login_name | *rolename* [, expand_up | expand_down]}

Any user can execute sp_displayroles to see his or her own roles. Only the system security officer can view information about roles granted to other users.

Viewing user roles in a hierarchy

Use role_contain to determine whether any role you specify contains any other role you specify:

role_contain (["*role1*", "*role2*"])

If *role1* is contained by *role2*, role_contain returns 1.

Any user can execute role_contain.

Determining mutual exclusivity

Use the mut_excl_roles function to determine whether any two roles assigned to you are mutually exclusive, and the level at which they are mutually exclusive:

mut_excl_roles(*role1*, *role2*, {membership | activation})

Any user can execute mut_excl_roles. If the specified roles, or any role contained by either specified role, are mutually exclusive, mut_excl_roles returns 1; if the roles are not mutually exclusive, mut_excl_roles returns 0.

Determining role activation

To find all active roles for the current login session of Adaptive Server, use:

```
sp_activeroles [expand_down]
```

expand_down displays the hierarchy of all roles contained by any roles granted to you.

Any user can execute sp_activeroles.

Checking for roles in stored procedures

Use has_role within a stored procedure to guarantee that only users with a specific role can execute the procedure. Only has_role provides a fail-safe way to prevent inappropriate access to a particular stored procedure.

You can use grant execute to grant execute permission on a stored procedure to all users who have been granted a specified role. Similarly, revoke execute removes this permission.

However, grant execute permission does not prevent users who do not have the specified role from being granted execute permission on a stored procedure. To ensure, for example, that all users who are not system administrators can never be granted permission to execute a stored procedure, use has_role within the stored procedure itself to check whether the invoking user has the correct role to execute the procedure.

has_role takes a string for the required role and returns 1 if the invoker possesses it. Otherwise, it returns 0.

For example, here is a procedure that uses has_role to see if the user has the sa_role role:

```
create proc test_proc
as
if (has_role("sa_role") = 0)
begin
    print "You don't have the right role"
    return -1
end
else
    print "You have System Administrator role"
    return 0
```

Granting and revoking roles

After a role is defined, it can be granted to any login account or role in the server, provided that it does not violate the rules of mutual exclusivity and hierarchy. Table 5-3 lists the tasks related to roles, the role required to perform the task, and the command to use.

Table 5-3: Tasks, required roles, and commands to use

Task	Required role	Command
Grant the sa_role role	System administrator	grant role
Grant the sso_role role	System security officer	grant role
Grant the oper_role role	System security officer	grant role
Grant user-defined roles	System security officer	grant role
Create role hierarchies	System security officer	grant role
Modify role hierarchies	System security officer	revoke role
Revoke system roles	System security officer	revoke role
Revoke user-defined roles	System security officer	revoke role

Granting roles

To grant roles to users or other roles, use:

grant role role_granted [{, *role_granted*}...]
to *grantee* [{, *grantee*}...]

where:

- *role_granted* – is the role being granted. You can specify any number of roles to be granted.
- *grantee* – is the name of the user, role, or login profile. You can specify any number of grantees.

All roles listed in the grant statement are granted to all grantees. If you grant one role to another, it creates a role hierarchy.

For example, to grant Susan, Mary, and John the “financial_analyst” and the “payroll_specialist” roles, enter:

```
grant role financial_analyst, payroll_specialist
  to susan, mary, john
```

Understanding *grant* and roles

Use the grant command to grant permission on objects to all users who have been granted a specified role, whether system or user-defined. This allows you to restrict use of an object to users who have been granted any of these roles:

- Any system-defined role
- Any user-defined role

A role can be granted only to a login account, another role, or login profile.

Grant permission to a role does not prevent users who do *not* have the specified role from being granted the same permission, directly or through a group. To ensure, for example, that only system administrators can successfully execute a stored procedure, use the has_role system function within the stored procedure itself to check that the user has been granted and has activated the requisite role. See "Displaying information about roles" on page 163.

Permissions granted to roles override permissions granted to users or groups. For example, assume John has been granted the system security officer role, and sso_role has been granted permission on the sales table. If John's individual permission on sales is revoked, he can still access sales when he has sso_role active because his role permissions override his individual permissions.

Revoking roles

Use revoke role to revoke roles from users, other roles, and login profiles:

revoke role *role_name* [{, *role_name*}...]from *grantee* [{, *grantee*}...]

where:

- *role_name* – is the role being revoked. You can specify any number of roles to be revoked.
- *grantee* – is the name of the user or role. You can specify any number of grantees.

All roles listed in the revoke statement are revoked from all grantees.

Roles granted to login profiles

A role granted to a login profile can be activated by any user assigned that profile. See "Granting roles to login profiles" on page 62.

Securing role passwords

In versions of Adaptive Server earlier than 15.7, role passwords were stored using Sybase-proprietary encryption in the syssrvroles system table. as of Adaptive Server version 15.7, role passwords are stored securely on-disk as SHA-256 digests.

When you upgrade Adaptive Server to version 15.7 or later, and activate a role password for the first time after the upgrade, Adaptive Server encrypts the role password and stores it as an SHA-256 digest.

You cannot downgrade a role password that has been encrypted in SHA-256; instead, upon downgrade, Adaptive Server truncates the role password and locks the role. The administrator must then reset the password and unlock the role after the downgrade.

Note In a high availability environment, those role passwords that are upgraded on first use on a primary server are also upgraded on its companion server.

Character set considerations

In versions of Adaptive Server earlier than 15.7, passwords used the server's default character set before they were encrypted. This changed, and in Adaptive Server now automatically converts passwords to a canonical—that is, a universal standardized—form. This automatic conversion prevents role-activation failures due to mismatched character mapping when you change the default character set.

Locked roles and *syssrvroles*

You can configure a role to lock automatically after a certain number of failed role-activation attempts using the max failed_logins option, or manually using alter role *rolename* lock. Adaptive Server stores information about locked roles in the syssrvroles system table:

- lockdate – indicates when the role was locked. lockdate is set to the datetime when the role was locked.
- locksuid – indicates who locked the role.
- lockreason – indicates why the role was locked. lockreason is coded into an integer that can be represented with an internationalized message. Each reason has a message in the MSGDB database added to identify the reason in the local language.

Adaptive Server resets these to NULL when a role is unlocked.

The values and descriptions are:

Values for lockreason	Value for locksuid	Description of lockreason of role
NULL	NULL	Role has not been locked
1	suid of caller of alter role	Role locked by suid by manually executing alter role *rolename* lock
2	suid of user whose last attempted role activation led to the role getting locked	Role locked by Adaptive Server due to failed-role activation attempts reaching maximum number of failed logins

Note If you are using high availability functionality, both the primary and companion servers are updated when you update the syssrvroles columns.

Login password policy checks to role passwords

In Adaptive Server version 15.7, the password complexity options that are applicable to login passwords are also applied to role passwords. The following options check which are extended to role passwords:

- disallow simple passwords
- min digits in password
- min alpha in password
- min special char in password

- min upper char in password
- min lower char in password
- systemwide password expiration
- password exp warn interval
- minimum password length
- maximum failed logins
- expire login

High-availability support for password policy options

The Adaptive Server high-availability functionality synchronizes these password policy options between primary and secondary servers:

- disallow simple passwords
- min digits in password
- min alpha in password
- min special char in password
- min upper char in password
- min lower char in password
- systemwide password expiration
- password exp warn interval
- minimum password length
- maximum failed login
- expire login
- keypair regeneration period
- keypair error retry wait
- keypair error retry count

Adaptive Server uses a “password policy” quorum attribute to check the inconsistency of values on both the primary and secondary servers. A high-availability advisory check succeeds when all those value are the same on both servers, and fail when the values differ. For example:

```
sp_companion "MONEY1", do_advisory, 'all'
```

```
go
Attribute Name   Attrib Type  Local Value  Remote Value  Advisory
--------------   -----------  -----------  -----------  ------
expire login     password po   1            0            2
maximum failed   password po   3            5            2
min alpha in pa  assword po   10           12            2
```

A value of 2 set in the advisory column of the output indicates that the user cannot proceed with the cluster operation unless the values on both the companions match.

The output of sp_companion do_advisory also indicates the inconsistency in any of the particular password policy checks on both servers.

Setting up Adaptive Server for roles

Installing

Before using the role functionality, make sure Adaptive Server has additional disk space in the master database and transaction log for the columns added to the syssrvroles table. A database administrator can use the alter database command to add the additional space.

To identify the density of roles per page and log space you need for role password changes, use sp_help syssrvroles and sp_helpdb. You can then compare the values of:

- The values of the log space from before and after a specific number of password changes
- The specific number of set role with passwd commands that update syssrvroles with dates

Upgrading Adaptive Server

During the upgrade process, Adaptive Server automatically adds locksuid, lockreason, and lockdate into syssrvroles. These columns are nullable, and have a default value of NULL after the upgrade. Values are set only when needed.

Downgrading Adaptive Server

When you downgrade Adaptive Server to version 15.5, Adaptive Server truncates and locks role passwords. In addition, Adaptive Server does not support the use of allow password downgrade for role passwords.

After a downgrade, the administrator should reset the role passwords and unlock the role accounts before using them again.

During the downgrade process, Adaptive Server:

- Truncates role passwords and locks roles
- Removes any attributes in sysattributes under class 35, as well as class 35 itself
- Removes locksuid, lockreason, and lockdate columns from syssrvroles

The actions to downgrade a password occur when you execute sp_downgrade. in single-user mode. A dataserver started with a “-m” command line option starts the server in single-user mode and allows only the system administrator to log in.

In this example, executing sp_downgrade results in the password of the “doctor_role” role becoming locked and truncated. The administrator can redirect this output to a file so that the passwords for these roles can be reset:

```
1> sp_downgrade 'downgrade','15.5',1
2> go
Downgrade from 15.7.0.0 to 15.5.0.0 (command: 'downgrade')

Checking databases for downgrade readiness.

There are no errors which involve encrypted columns.

Executing downgrade step 2 [dbcc markprocs(@dbid)] for :
- Database: master (dbid: 1)
sql comman is: dbcc markprocs(@dbid)
...

Executing downgrade step 26 [delete statistics syssrvroles(password) if exists (select 1
from syssrvroles where password is not
null) begin print "Truncating password and locking following role(s)" select name from
syssrvroles where password is not null update
syssrvroles set password = null, status = (status | @lockrole) where password is not null
end update syscolumns set length = 30
where id = object_id('syssrvroles') and name = 'password' update syssrvroles set locksuid
= null, lockreason = null, lockdate = null
where locksuid is not null or lockreason is not null or lockdate is not null delete
syscolumns where id = object_id('syssrvroles')
and name in ('locksuid', 'lockreason', 'lockdate')] for :
```

```
- Database: master (dbid: 1)
sql comman is: delete statistics syssrvroles(password) if exists (select 1 from
syssrvroles where password is not null) begin print
"Truncating password and locking following role(s)" select name from syssrvroles where
password is not null update syssrvroles set
password = null, status = (status | @lockrole) where password is not null end update
syscolumns set length = 30 where id =
object_id('syssrvroles') and name = 'password' update syssrvroles set locksuid = null,
lockreason = null, lockdate = null where
locksuid is not null or lockreason is not null or lockdate is not null delete syscolumns
where id = object_id('syssrvroles') and
name in ('locksuid', 'lockreason', 'lockdate')

Truncating password and locking following role(s)
 name
 ------------------------------------------------------------
 doctor_role

Executing downgrade step 27 [delete sysattributes where class = 35 delete sysattributes
where class = 39 update syslogins set lpid =
null, crsuid = null where lpid is not null or crsuid is not null delete syscolumns where
id = object_id('syslogins') and name in
('lpid', 'crsuid') delete syslogins where (status & @lp_status) = @lp_status update
syslogins set status = status & ~(@exempt_lock)
where (status & @exempt_lock) = @exempt_lock] for :
- Database: master (dbid: 1)
sql comman is: delete sysattributes where class = 35 delete sysattributes where class =
39 update syslogins set lpid = null, crsuid
= null where lpid is not null or crsuid is not null delete syscolumns where id =
object_id('syslogins') and name in ('lpid',
'crsuid') delete syslogins where (status & @lp_status) = @lp_status update syslogins set
status = status & ~(@exempt_lock) where
(status & @exempt_lock) = @exempt_lock

...

(return status = 0)
```

Additional messages appear in the error log to identify steps that occurred during sp_downgrade and any system errors that may occur, such as in this example of error log output for the example downgrade procedure:

```
00:0006:00000:00006:2011/06/28 06:21:23.95 server  Preparing ASE downgrade from 15.7.0.0
to 15.5.0.0.
00:0006:00000:00006:2011/06/28 06:21:24.12 server  Starting downgrading ASE.
00:0006:00000:00006:2011/06/28 06:21:24.12 server  Downgrade : Marking stored procedures
to be recreated from text.
00:0006:00000:00006:2011/06/28 06:21:26.13 server  Downgrade : Removing full logging
modes from sysattributes.
00:0006:00000:00006:2011/06/28 06:21:26.13 server  Downgrade : Downgrading data-only
locked table rows.
```

```
00:0006:00000:00006:2011/06/28 06:21:26.13 server  Downgrade : Removing full logging
modes from sysattributes.
00:0006:00000:00006:2011/06/28 06:21:26.13 server  Downgrade : Removing column
sysoptions.number.
00:0006:00000:00006:2011/06/28 06:21:26.13 server  Downgrade : Removing srvprincipal
column from sysservers system table
00:0006:00000:00006:2011/06/28 06:21:26.14 server  Downgrade : Removing 'automatic master
key access' configuration parameter.
00:0006:00000:00006:2011/06/28 06:21:26.14 server  Downgrade : Removing DualControl
sysattribute rows
00:0006:00000:00006:2011/06/28 06:21:26.14 server  Downgrade : Downgrading sysattributes
system table.
00:0006:00000:00006:2011/06/28 06:21:26.16 server  Downgrade : Downgrading syscomments
system table.
00:0006:00000:00006:2011/06/28 06:21:26.19 server  Downgrade : Truncated role password,
locked role and removed columns locksuid, lockreason, lockdate from syssrvroles
00:0006:00000:00006:2011/06/28 06:21:26.21 server  Downgrade : Removing catalog changes
for RSA Keypair Regeneration Period and Login Profile
00:0006:00000:00006:2011/06/28 06:21:26.21 server  Downgrade : Turning on database
downgrade indicator.
00:0006:00000:00006:2011/06/28 06:21:26.21 server  Downgrade : Resetting database version
indicator.
00:0006:00000:00006:2011/06/28 06:21:26.21 server  ASE downgrade completed.
```

After running sp_downgrade, shut down the server to avoid new logins or other actions that may modify data or system catalogs.

If you restart Adaptive Server at version 15.7:

- After successfully executing sp_downgrade and shutting down the server, Adaptive Server performs internal upgrade actions again, and any changes to system tables are upgraded to version 15.7.
- Before starting an earlier version of Adaptive Server to which you are reverting, you must execute sp_downgrade again.

You can enable locked roles and trucnated password. In this example, the output of sp_displayroles shows that the downgrade process has locked "doctor_role" and truncated its password:

```
select srid,status,name,password from syssrvroles
go
suid   status  name                password
------ ------- ------------------- -----
33     2       doctor_role         NULL
```

This unlocks the role:

```
alter role doctor_role unlock
```

This sets a new password for the role:

```
alter role doctor_role add passwd "dProle1"
```

Running sp_displayroles now displays that the role is unlocked and has a password:

```
select srid,status,name,
"vers"=substring(password,2,1) from syssrvroles
go
suid   status  name                vers
------ ------- ------------------- -----
33     0       doctor_role         0x05
```

CHAPTER 6 Managing User Permissions

This chapter describes the use and implementation of user permissions.

Overview

Discretionary access controls (DACs) allow you to restrict access to objects and commands based on a user's identity, group membership and active roles. The controls are "discretionary" because a user with a certain access permission, such as an object owner, can choose whether to pass that access permission on to other users.

Adaptive Server's discretionary access control system recognizes the following types of users:

- Users possessing one or more system defined roles: system administrator, system security officer, operator, and other roles
- Database owners
- Database object owners
- Other users

System administrators (those users with sa_role) operate outside the DAC system and have access permissions on all database objects at all times except encryption keys (see *User Guide for Encrypted Columns*). System security officers can always access the audit trail tables in the sybsecurity database to track accesses by system administrators.

If you have the sa_role, all grants permissions for create database, set tracing, and connect as well, if you issue the grant command in the master database.

Database owners do not automatically receive permissions on objects owned by other users; however, they can:

- Temporarily acquire all permissions of a user in the database by using the setuser command to assume the identity of that user.
- Permanently acquire permission on a specific object by using the setuser command to assume the identity of the object owner, and then using grant commands to grant the permissions.

For details on assuming another user's identity to acquire permissions on a database or object, see "Acquiring the permissions of another user" on page 193.

Object owners can grant access to those objects to other users and can also grant other users the ability to pass the access permission to other users. You can give various permissions to users, groups, and roles with the grant command, and rescind them with the revoke command. Use grant and revoke to give users permission to:

- Create databases
- Create objects within a database
- Execute certain commands such as dbcc and set proxy
- Access specified tables, views, stored procedures, encryption keys, and columns

grant and revoke can also be used to set permissions on system tables.

For permissions that default to "public," no grant or revoke statements are needed.

Some commands can be used at any time by any user, with no permission required. Others can be used only by users of a particular status and they are not transferable.

The ability to assign permissions for the commands that can be granted and revoked is determined by each user's role or status (as system administrator, database owner, system security officer, or database object owner), and by whether the user was granted a role with permission that includes the option to grant that permission to other users.

You can also use views and stored procedures as security mechanisms. See "Using views and stored procedures as security mechanisms" on page 207.

Permissions for creating databases

Only a system administrator can grant permission to use the create database command. The user that receives create database permission must also be a valid user of the master database because all databases are created while using master.

In many installations, the system administrator maintains a monopoly on create database permission to centralize control of database placement and database device space allocation. In these situations, a system administrator creates new databases on behalf of other users, and then transfers ownership to the appropriate user.

To create a database that is to be owned by another user:

1. Issue the create database command in the master database.
2. Switch to the new database with the use command.
3. Execute sp_changedbowner.

Changing database ownership

Use sp_changedbowner to change the ownership of a database. Often, system administrators create the user databases, then give ownership to another user after some of the initial work is complete. Only the system administrator can execute sp_changedbowner.

Sybase suggests that you transfer ownership before the user has been added to the database, and before the user has begun creating objects in the database. The new owner must already have a login name on Adaptive Server, but cannot be a user of the database, or have an alias in the database. You may have to use sp_dropuser or sp_dropalias before you can change a database's ownership, and you may have to drop objects before you can drop the user.

Issue sp_changedbowner in the database whose ownership is to be changed. The syntax is:

sp_changedbowner *loginame* [, true]

This example makes "albert" the owner of the current database and drops aliases of users who could act as the old "dbo:"

```
sp_changedbowner albert
```

Include the true parameter to transfer aliases and their permissions to the new "dbo."

Note You cannot change the ownership of the master, model, tempdb, or sybsystemprocs databases and should not change the ownership of any other system databases.

Database owner privileges

Database owners and system administrators are the only users who can grant object creation permissions to other users (except for create encryption key and create trigger permission which can only be granted by the system security officer). The database owner has full privileges to do anything inside that database, and must explicitly grant permissions to other users with the grant command.

Permission to use the following commands is automatically granted to the database owner and cannot be transferred to other users:

- checkpoint
- dbcc
- alter database
- online database

- drop database
- dump database
- dump transaction
- grant (object creation permissions)
- load database
- load transaction
- revoke (object creation permissions)
- setuser

Database owners can grant or revoke permission to:

- Use these commands: create default, create procedure, create rule, create table, create view.

  Database owners can grant permission to use create database, set tracing, and connect if they have the sa_role and are in the master database.
- all – if you are the database owner, all grants permisions for all create commands except create database, create trigger and create encryption key.
- default permissions on system tables
- Use dbcc commands:checkalloc, checkcatalog, checkdb, checkindex, checkstorage, checktable, checkverify, fix_text, indexalloc, reindex, tablealloc, textalloc, tune

Database object owner privileges

A user who creates a database object (a table, view, encryption key, or stored procedure) owns the object and is automatically granted all object access permissions on it. Users other than the object owner, including the owner of the database, are automatically denied all permissions on that object, unless they are explicitly granted by either the owner or a user who has grant permission on that object.

As an example, suppose that Mary is the owner of the pubs2 database, and has granted Joe permission to create tables in it. Now Joe creates the table new_authors; he is the owner of this database object.

Initially, object access permissions on new_authors belong only to Joe. Joe can grant or revoke object access permissions for this table to other users.

The following object altering permissions default to the owner of a table and cannot be transferred to other users:

- alter table
- drop table
- create index

Permission to use the grant and revoke commands to grant specific users select, insert, update, delete, references, decrypt, truncate table, update statistics, delete statistics, and execute permissions on specific database objects can be transferred, using the grant with grant option command.

Permission to drop an object—a table, view, index, stored procedure, rule, encryption key, trigger, or default—defaults to the object owner and cannot be transferred.

Other database user privileges

Permissions are granted to or revoked from other database users by object owners, database owners, users who were granted permissions with grant option, the system administrator, or a system security officer. These users are specified by user name, group name, or the keyword public.

All users inherit the permissions granted to the roles assigned to them after they have activated those roles.

Permissions on system procedures

Set permissions on system procedures in the sybsystemprocs database, where the system procedures are stored.

Security-related system procedures can be run only by system security officers. Certain other system procedures can be run only by system administrators.

Some of the system procedures can be run only by database owners. These procedures make sure that the user executing the procedure is the owner of the database from which they are being executed.

Other system procedures can be executed by any user who has been granted permission. A user must have permission to execute a system procedure in all databases, or in none of them.

Users who are not listed in sybsystemprocs..sysusers are treated as “guest” in sybsystemprocs, and are automatically granted permission on many of the system procedures. To deny a user permission on a system procedure, the system administrator must add him or her to sybsystemprocs..sysusers and issue a revoke statement that applies to that procedure. The owner of a user database cannot directly control permissions on the system procedures from within his or her own database.

Granting and revoking permissions

You can control the following types of permissions with grant and revoke:

- Object access permissions
- Permission to select from functions
- Permission to execute commands
- Permission to execute dbcc commands
- Permission to execute some set commands
- Default permissions on system tables

Each database has its own independent protection system. Having permission to use a certain command in one database does not give you permission to use that command in other databases.

Object access permissions

Object access permissions regulate the use of certain commands that access certain database objects. For example, you must explicitly be granted permission to use the select command on the authors table. Object access permissions are granted and revoked by the object owner (and system administrators or system security officers), who can grant them to other users.

Table 6-1 lists the types of object access permissions and the objects to which they apply.

Table 6-1: Permissions and the objects to which they apply

Permission	Object
select	Table, view, column
update	Table, view, column
insert	Table, view
delete	Table, view
references	Table, column
execute	Stored procedure
truncate table	Table
delete statistics	Table
update statistics	Table
decrypt	Table, view, column
select	Encryption key

The references permission refers to referential integrity constraints that you can specify in an alter table or create table command. The decrypt permission refers to the permission required to decrypt an encrypted column. An encryption key's select permission refers to the permissions required to use encryption keys in create table, alter table or select into command to encrypt columns. The other permissions refer to SQL commands. Object access permissions default to the object's owner, or system administrators or system security officers for decrypt on an encrypted column and select on an encryption key, and can be granted to other users.

If several users grant access to an object to a particular user, the user's access remains until access is revoked by all those who granted access. If a system administrator revokes access, the user is denied access, even though other users have granted access.

Use the grant command to grant object access permissions. See the *Reference Manual: Commands*.

Concrete identification

Adaptive Server identifies users during a session by login name. This identification applies to all databases in the server. When the user creates an object, the server associates both the owner's database user ID (*uid*) and the creator's login name with the object in the sysobjects table. This information concretely identifies the object as belonging to that user, which allows the server to recognize when permissions on the object can be granted implicitly.

If an Adaptive Server user creates a table and then creates a procedure that accesses the table, any user who is granted permission to execute the procedure does not need permission to access the object directly. For example, by giving user "mary" permission on proc1, she can see the id and descr columns from table1, though she does not have explicit select permission on the table:

```
create table table1 (id     int,
                     amount money,
                     descr    varchar(100))
```

```
create procedure proc1 as select id, descr from table1
```

```
grant execute on proc1 to mary
```

There are, however, some cases where implicit permissions are only useful if the objects can be concretely identified. One case is where aliases and cross-database object access are both involved.

Special requirements for SQL92 standard compliance

When you have used the set command to turn ansi_permissions on, additional permissions are required for update and delete statements. Table 6-2 summarizes the required permissions.

Table 6-2: ANSI permissions for update and delete

	Permissions required: *set ansi_permissions off*	**Permissions required: *set ansi_permissions on***
update	update permission on columns where values are being set	update permission on columns where values are being set and select permission on all columns appearing in the where clause select permission on all columns on the right side of the set clause
delete	delete permission on the table	delete permission on the table from which rows are being deleted and select permission on all columns appearing in the where clause

If ansi_permissions is on and you attempt to update or delete without having all the additional select permissions, the transaction is rolled back and you receive an error message. If this occurs, the object owner must grant you select permission on all relevant columns.

Examples of granting object access permissions

This statement gives Mary and the "sales" group permission to insert into and delete from the titles table:

```
grant insert, delete
on titles
to mary, sales
```

This statement gives Harold permission to use the stored procedure makelist:

```
grant execute
on makelist
to harold
```

This statement grants permission to execute the custom stored procedure sa_only_proc to users who have been granted the system administrator role:

```
grant execute
on sa_only_proc
to sa_role
```

This statement gives Aubrey permission to select, update, and delete from the authors table and to grant the same permissions to other users:

```
grant select, update, delete
on authors
to aubrey
with grant option
```

Examples of revoking object access permissions

These two statements both revoke permission for all users except the table owner to update the price and total_sales columns of the titles table:

```
revoke update
on titles (price, total_sales)
from public
```

This statement revokes permission from Clare to update the authors table, and simultaneously revokes that permission from all users to whom she had granted that permission:

```
revoke update
on authors
from clare
cascade
```

This statement revokes permission from operators to execute the custom stored procedure new_sproc:

```
revoke execute
on new_sproc
from oper_role
```

Granting permissions on dbcc commands

System administrators can grant the permission to execute dbcc commands to users and roles that do not have system administrator-level privileges in Adaptive Server. This **discretionary access control** allows system administrators to control access to database objects or to certain database- and server-level actions.

See the *Reference Manual: Commands* for the complete dbcc syntax.

Server-wide and database-specific *dbcc* commands

dbcc commands are either:

- Database-specific – dbcc commands that execute on a particular target database (for example, checkalloc, checktable, checkindex, checkstorage, checkdb, checkcatalog, checkverify, fix_text, indexalloc, reindex, tablealloc, and textalloc). Although these commands are database-specific, only system administrators can grant or revoke them.
- Server-wide – dbcc commands such as tune that are effective server-wide and are not associated with any particular database. These commands are granted server-wide by default and are not associated with any database.

System administrators can allow users to execute the dbcc command in all databases by making them valid users in those databases. However, it may be more convenient to grant dbcc to roles instead of individual users, since this allows users to use databases as a “guest” user instead of requiring that they each be added manually to the database.

From a security administration perspective, system administrators may prefer to grant permission to execute database-specific dbcc commands server-wide. For example, you can execute grant dbcc checkstorage on all databases to a user-defined role called storage_admin_role, thereby eliminating the need to execute grant dbcc checkstorage to storage_admin_role in every database.

The following commands are effective server-wide, but are not database-specific:

- Server-wide dbcc commands such as tune.
- Database-specific dbcc commands that are granted server-wide, such as grant dbcc checkstorage granted to storage_admin_role.

dbcc grantees and users in databases

grant dbcc and revoke dbcc work on users in databases.

Since roles are automatically added as users in a database on their first grant in a database, there are no additional requirements when roles are granted dbcc privileges. Logins must be valid users in the database where permissions are granted. Valid users include "guest."

For server-wide dbcc commands, the login must be a valid user in master, and the system administrator must be in master when granting the permission.

For database-specific dbcc commands the login should be a valid user in the target database.

Permissions on system tables

Permissions for use of the system tables can be controlled by the database owner, just like permissions on any other tables. When a database is created, select permission on some system tables is granted to public, and select permission on some system tables is restricted to administrators. For some other tables, a few columns have restricted select permissions for public.

To determine the current permissions for a particular system table, execute:

sp_helprotect *system_table_name*

For example, to check the permissions of syssrvroles in the master database, execute:

```
use master
go
```

```
sp_helprotect syssrvroles
go
```

The default situation is that no users—including database owners—can modify the system tables directly. Instead, the T-SQL commands and the system procedures supplied with Adaptive Server modify the system tables. This helps guarantee integrity.

Warning! Although Adaptive Server provides a mechanism that allows you to modify system tables, Sybase strongly recommends that you do not do so.

Granting default permissions to system tables and stored procedures

The grant and revoke commands include the default permissions parameter. installmodel or installmaster do not grant default permissions on any system tables (see the table below). Instead, the default permissions on the system tables are assigned when Adaptive Server builds a new database. The partial syntax is:

```
grant default permissions on system tables
revoke default permissions on system tables
```

where default permissions on system tables specifies that you grant or revoke the default permissions for the following system tables when you issue it from any database:

sysalternates	sysjars	sysquerymatrics	systhresholds
sysattributes	syskeys	sysqueryplans	systypes
syscolumns	syslogs	sysreferences	sysusermessages
syscomments	sysobjects	sysroles	sysusers
sysconstraints	syspartitionkeys	syssegments	sysxtypes
sysdepends	syspartitions	sysslices	
sysgams	sysprocedures	sysstatistics	
sysindexes	sysprotects	systabstats	

Default permissions applies select to public on all system tables, with these exceptions:

- Revokes select on syscolumns(encrkeyid) from public
- Revokes select on syscolumns(encrkeydb) from public
- Grants select on syscolumns to sso_role

- Revokes sysobjects(audflags) permissions from public
- Grants permissions for sysobjects to sso_role
- Revokes select on all columns of sysencryptkeys from public
- Grants select on all columns of sysencryptkeys to sso_role

If you run this command from the master database, default permissions for the following system tables are granted or revoked:

syscharsets	syslanguages	sysmessages	sysservers
sysconfigures	syslisteners	sysmonitor	syssessions
syscurconfigs	syslocks	sysprocesses	syssrvroles
sysdatabases	syslogin	sysremotelogins	systimeranges
sysdevices	sysloginrole	sysresourcelimits	systransactions
sysengines	syslogshold	syssecmechs	sysusages

The command also makes the following changes:

- Revokes select on sysdatabases(audflags) from public
- Revokes select on syscolumns(encrkeyid) from public
- Revokes select on syscolumns(encrkeydb) from public
- Grants select on syscolumns to sso_role
- Revokes select on sysdatabases(deftabaud) from public
- Revokes select on sysdatabases(defvwaud) from public
- Revokes select on sysdatabases(defpraud) from public
- Revokes select on sysdatabases(audflags2) from public
- Grants select on sysdatabases to sso_role.
- Revokes select on syslogins(password) to public
- Revokes select on syslogins(audflags) from public
- Grants select on syslogins to sso_role
- Revokes select on syslisteners(net_type) from public
- Revokes select on syslisteners(address_info) from public
- grant select on syslisteners to sso_role
- Revokes select on syssrvroles(srid) from public
- Revokes select on syssrvroles(name) from public

- Revokes select on syssrvroles(password) from public
- Revokes select on syssrvroles(pwdate) from public
- Revokes select on syssrvroles(status) from public
- Revokes select on syssrvroles(logincount) from public
- grant select on syssrvroles to sso_role
- Revokes select on sysloginroles(suid) from public
- Revokes select on sysloginroles(srid) from public
- Revokes select on sysloginroles(status) from public
- Revokes select on sysloginroles to sso_role

Combining *grant* and *revoke* statements

Assign specific permissions to specific users, or, if most users are going to be granted most privileges, it may be easier to assign all permissions to all users, and then revoke specific permissions from specific users.

For example, a database owner can grant all permissions on the titles table to all users by issuing:

```
grant all
on titles
to public
```

The database owner can then issue a series of revoke statements, for example:

```
revoke update
on titles (price, advance)
from public
revoke delete
on titles
from mary, sales, john
```

grant and revoke statements are order-sensitive: in case of a conflict, the most recently issued statement supersedes all others.

Note Under SQL rules, you must use the grant command before using the revoke command, but the two commands cannot be used within the same transaction. Therefore, when you grant "public" access to objects, and then revoke that access from an individual, there is a short period of time during which the individual has access to the objects in question. To prevent this situation, use the create schema command to include the grant and revoke clauses within one transaction.

Understanding permission order and hierarchy

grant and revoke statements are sensitive to the order in which they are issued. For example, if Jose's group has been granted select permission on the titles table and then Jose's permission to select the advance column has been revoked, Jose can select all the columns except advance, while the other users in his group can still select all the columns.

A grant or revoke statement that applies to a group or role changes any conflicting permissions that have been assigned to any member of that group or role. For example, if the owner of the titles table has granted different permissions to various members of the sales group, and wants to standardize, he or she might issue the following statements:

```
revoke all on titles from sales
grant select on titles(title, title_id, type,
        pub_id)
    to sales
```

Similarly, a grant or revoke statement issued to public changes, for all users, all previously issued permissions that conflict with the new regime.

The same grant and revoke statements issued in different orders can create entirely different situations. For example, the following set of statements leaves Jose, who belongs to the public group, without any select permission on titles:

```
grant select on titles(title_id, title) to jose
revoke select on titles from public
```

In contrast, the same statements issued in the opposite order result in only Jose having select permission and only on the title_id and title columns:

```
revoke select on titles from public
grant select on titles(title_id, title) to jose
```

When you use the keyword public with grant, you are including yourself. With revoke on object creation permissions, you are included in public unless you are the database owner. With revoke on object access permissions, you are included in public unless you are the object owner. You may want to deny yourself permission to use your own table, while giving yourself permission to access a view built on it. To do this, you must issue grant and revoke statements explicitly setting your permissions. You can reinstitute the permission with a grant statement.

Grant dbcc and set proxy issue warning for fipsflagger

grant dbcc and set proxy issue the following warning when they are issued while set fipsflagger option is enabled:

```
SQL statement on line number 1 contains Non-ANSI text.
The error is caused due to the use of DBCC.
```

Acquiring the permissions of another user

Adaptive Server provides two ways to acquire another user's identity and permissions status:

- A database owner can use the setuser command to "impersonate" another user's identity and permissions status in the current database. See "Using setuser" on page 193.
- **proxy authorization** allows one user to assume the identity of another user on a server-wide basis. See "Using proxy authorization" on page 194.

Using setuser

A database owner may use setuser to:

- Access an object owned by another user
- Grant permissions on an object owned by another user
- Create an object that will be owned by another user

- Temporarily assume the DAC permissions of another user for some other reason

While the setuser command enables the database owner to automatically acquire another user's DAC permissions, the command does not affect the roles that have been granted.

setuser permission defaults to the database owner and cannot be transferred. The user being impersonated must be an authorized user of the database. Adaptive Server checks the permissions of the user being impersonated.

System administrators can use setuser to create objects that will be owned by another user. However, system administrators operate outside the DAC permissions system; therefore, they need not use setuser to acquire another user's permissions. The setuser command remains in effect until another setuser command is given, the current database is changed, or the user logs off.

The syntax is:

setuser ["*user_name*"]

where *user_name* is a valid user in the database that is to be impersonated.

To reestablish your original identity, use setuser with no value for *user_name*.

This example shows how the database owner would grant Joe permission to read the authors table, which is owned by Mary:

```
setuser "mary"
grant select on authors to joe
setuser     /*reestablishes original identity*/
```

Using proxy authorization

With the proxy authorization capability of Adaptive Server, system security officers can grant selected logins the ability to assume the security context of another user, and an application can perform tasks in a controlled manner on behalf of different users. If a login has permission to use proxy authorization, the login can impersonate any other login in Adaptive Server.

Warning! The ability to assume another user's identity is extremely powerful and should be limited to trusted administrators and applications. grant set proxy ... restrict role can be used to restrict which roles users cannot acquire when switching identities.

A user executing set proxy or set session authorization operates with both the login name and server user ID of the user being impersonated. The login name is stored in the name column of master..syslogins and the server user ID is stored in the suid column of master..syslogins. These values are active across the entire server in all databases.

Note set proxy and set session authorization are identical in function and can be used interchangeably. The only difference between them is that set session authorization is ANSI-SQL92-compatible, and set proxy is a Transact-SQL extension.

Using set proxy to restrict roles

Grant set proxy...restrict role to restrict which roles cannot be acquired when switching identities.

The syntax for set proxy is:

grant set proxy to *user* | *role*
[restrict role *role_list* | all | system]

where:

- *role_list* – list of roles you are restricting for the target login. The grantee must have all roles on this list, or the set proxy command fails.
- *all* – ensures the grantee can run set proxy only for those users who have the same roles, or a subset of the roles, as the grantee.
- *system* – ensures the grantee has the same set of system roles as the target login.

For example, this grants set proxy to user "joe" but restricts him from switching identities to any user with the sa, sso, or admin roles (however, if he already has these roles, he can set proxy for any user with these roles):

```
grant set proxy to joe
restrict role sa_role, sso_role, admin_role
```

When "joe" tries to switch his identity to a user with admin_role (in this example, Our_admin_role), the command fails unless he already has admin_role:

```
set proxy Our_admin_role
Msg 10368, Level 14, State 1:
Server 's', Line 2:Set session authorization permission
denied because the target login has a role that you do
```

```
not have and you have been restricted from using.
```

After "joe" is granted the admin_role and retries the command, it succeeds:

```
grant role admin_role to joe
set proxy Our_admin_role
```

For more information about the set proxy command, see the *Reference Manual: Commands*.

Executing proxy authorization

Follow these rules when you execute set proxy or set session authorization:

- You cannot execute set proxy or set session authorization from within a transaction.
- You cannot use a locked login for the proxy of another user. For example, if "joseph" is a locked login, the following command is not allowed:

  ```
  set proxy "joseph"
  ```

- You can execute set proxy or set session authorization from any database you are allowed to use. However, the *login_name* you specify must be a valid user in the database, or the database must have a "guest" user defined for it.
- Only one level is permitted; to impersonate more than one user, you must return to your original identity between impersonations.
- If you execute set proxy or set session authorization from within a procedure, your original identity is automatically resumed when you exit the procedure.

If you have a login that has been granted permission to use set proxy or set session authorization, you can set proxy to impersonate another user. The following is the syntax, where *login_name* is the name of a valid login in master..syslogins:

set proxy *login_name*

or

set session authorization *login_name*

Enclose the login name in quotation marks.

For example, to set proxy to "mary," execute:

```
set proxy "mary"
```

After setting proxy, check your login name in the server and your user name in the database. For example, assume that your login is “ralph” and that you have been granted set proxy authorization. You want to execute some commands as “sallyn” and as “rudolph” in pubs2 database. “sallyn” has a valid name (“sally”) in the database, but Ralph and Rudolph do not. However, pubs2 has a “guest” user defined. You can execute:

```
set proxy "sallyn"
go
use pubs2
go
select suser_name(), user_name()
go
------------------------------ -------------------
sallyn                         sally
```

To change to Rudolph, you must first change back to your own identity. To do so, execute:

```
set proxy "ralph"
select suser_name(), user_name()
go
------------------------------ --------------------
ralph                          guest
```

Notice that Ralph is a “guest” in the database.

Then execute:

```
set proxy "rudolph"
go
select suser_name(), user_name()
go
------------------------------ --------------------
rudolph                        guest
```

Rudolph is also a guest in the database because Rudolph is not a valid user in the database.

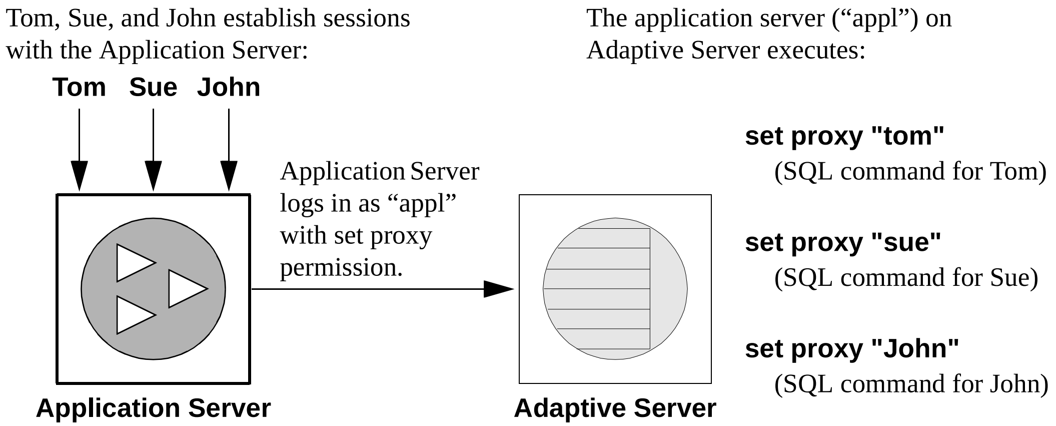
Now, impersonate the “sa” account. Execute:

```
set proxy "ralph"
go
set proxy "sa"
go
select suser_name(), user_name()
go
--------------------------- --------------------
sa                          dbo
```

Proxy authorization for applications

Figure 6-1 shows an application server logging in to Adaptive Server with the generic login “appl” to execute procedures and commands for several users. While “appl” impersonates Tom, the application has Tom’s permissions. Likewise, when “appl” impersonates Sue and John, the application has only Sue’s and John’s permissions, respectively.

Figure 6-1: Applications and proxy authorization



Changing database object ownership

A system security officer or database owner can transfer the ownership of database objects using the alter... modify owner command.

The command lets a database administrator manage the assignment of objects due to employee changes or to separate the creation ownership of database objects. For example, a key custodian can create an encryption key and then transfer the ownership of the encryption key to another user.

Supported object types

The ownership of the following objects can be transferred from one owner to another. The ownership of objects not listed below cannot be changed.

Objects for which the ownership can be changed explicitly:

- User tables
- Proxy tables
- Views
- Stored procedures
- User-defined functions
- Defaults
- Rules
- User-defined datatypes
- Encryption keys

Dependent objects for which the ownership cannot be changed explicitly. These objects are transferred implicitly when the ownership is the same as the explicitly transferred object:

- Triggers

  The ownership of a dbo-owned trigger cannot be altered if the trigger was created for a non-dbo-owned table/view.

- Declarative objects that are defined during the table/view creation
  - Defaults
  - Decrypt_defaults
  - Check constraints
  - Reference constraints
  - Partition conditions
  - Computed columns

Authorization

- System security officers have authorization to transfer ownership of all objects for which ownership transfer is supported.
- Database owners have authorization to transfer ownership of objects, other than encryption keys, with these restrictions:
  - The database object owner cannot transfer the ownership of objects concretely owned by the database owner.

An object is identified as concretely owned by a database owner if it carries the database owner user ID as sysobjects.uid, and null or the database owner's user name as sysobjects.loginame.

- A user aliased to the database owner cannot transfer the ownership of objects created by the database owner or concretely owned by the user.

  Database owner-created objects have a null value in sysobjects.loginame. Objects concretely owned by a user carries the user's username in sysobjects.loginame.

Use sp_helpuser to search for and list objects and corresponding owners.

Transferring ownership

Ownership transfer can be specific to an individual object, or multiple objects can be transferred in one command. Use preserve permissions to preserve explicitly granted permissions of an object.

For syntax, see alter...modify owner in *Reference Manual: Commands*.

In this example, the database owner transfers a table owned by john to eric.

```
alter table john.table_audit modify owner eric
```

To transfer the ownership of all tables owned by john to eric, a system security officer can execute:

```
alter table john.* modify owner eric
```

To transfer the ownership of all objects owned by john to eric, a system security officer can execute:

```
alter all john.* modify owner eric
```

Transferring ownership of objects in the system database

Use caution to change the ownership of objects in the following system databases that are supplied and managed by Sybase: sybsecurity, sybsystemdb, model, sybsystemprocs, sybsyntax, dbccdb, and tempdb. Do not change the ownership of system objects that are supplied and managed by Sybase, such as but not limited to, user tables with spt_ prefix, and system stored procedures with sp_ prefix. Changing the ownership of these objects can make the system unusable.

Transferring ownership of database owner objects

The database owner of nonsystem objects can transfer ownership using the parameter dbo.object_name. You cannot transfer the ownership of multiple objects using *.

Using *preserve permissions*

Specify preserve permissions to perserve all explicitly granted or revoked permissions on an object.

For example, bill granted select permission of table `bill_table` to mark. mark then granted select permission on table `bill_table` to john. If the ownership of the table is then transferred to eric with preserve permissions specified, mark and john retain their permission of `bill_table`.

In the following example, the system security officer transfers the ownership of view bill.vw_author to eric while keeping all existing explicitly granted permissions.:

```
alter view bill.vw_author_in_ca modify owner eric
    preserve permissions
```

Implicit permissions are not preserved when preserve permissions is specified.

For example, bill owns table bill.encr_table which has encrypted columns and the restricted decrypt permission configure option is set to 1. If the system security officer explicitly granted decrypt permission on bill.encr_table to bill, bill has the permissions alter, delete, insert, references, select, and update which he accrued through his ownership. He also has decrypt permission which he accrued through explicit granting by the system security officer. After the system security officer transfers the ownership on bill.encr_table to eric with preserve permissions, bill loses all permissions on the table except the decrypt permission.

When preserve permissions is not specified, after the ownership transfer, the previous owner loses permissions on the object, that are implicitly accrued through ownership. The new implicitly accrues permissions by being given ownership of the object.

Note For permissions that cannot be accrued through ownership, such as decrypt permissions, the system security officer or database owner must explicit again grant permission of the objects to the new owner.

Security issues

The system security officer or database owner should be aware of possible security issues.

For example, alice is a user in the Accounting database and has no access to the payroll data. She could create the procedure alicep that selects name and salary from Accounting.dbo.payroll, and then grant execute on alicep to public. If the system security officers accidentally changes the ownership of alicep to bill, a privileged user with access to the payroll data with preserve permissions option, all users can access the payroll information by executing the malicious procedure alicep because all the permissions are set to be preserved after the ownership change.

To avoid unauthorized usage, the system security officers or database owner can check existing permissions on an object using sp_helprotect.

Transferring ownership of encryption keys

System security officers and key owners can use alter encryption key or alter... modify owner to transfer encryption keys.

For information about the alter encryption key command, see *Reference Manual: Commands*.

Encryption key copy owners

When using the alter... modify owner command, the user who has been assigned a key copy cannot be the new owner of the encryption key.

After the owner of a encryption key changes, the assignees of key copies do not change. For example, user bill owns an encryption key named bill.encrkey and creates one key copy of the key, which he assigns to mark. After bill transfers the ownership of bill.encrkey to eric, mark still owns a copy of bill.encrkey.

Reporting on permissions

Table 6-3 lists the system procedures for reporting information about proxies, object creation, and object access permissions:

Table 6-3: System procedures for reporting on permissions

To report information on	Use
Proxies	system tables
Users and processes	sp_who
Permissions on database objects or users	sp_helprotect
Permissions on specific tables	sp_table_privileges
Permissions on specific columns in a table	sp_column_privileges

Querying the *sysprotects* table for proxy authorization

To display information about permissions that have been granted to—or revoked from—users, groups, and roles, query the sysprotects table. The action column specifies the permission. For example, the action value for set proxy or set session authorization is equal to 167.

You might execute this query:

```
select * from sysprotects where action = 167
```

The results provide the user ID of the user who granted or revoked the permission (column grantor), the user ID of the user who has the permission (column uid), and the type of protection (column protecttype). The protecttype column can contain these values:

- 0 for grant with grant
- 1 for grant
- 2 for revoke

For more information about the sysprotects table, see the *Reference Manual: Building Blocks*.

Displaying information about users and processes

sp_who displays information about all current Adaptive Server users and processes or about a particular user or process. The results of sp_who include the loginame and origname. If a user is operating under a proxy, origname contains the name of the original login. For example, assume that “ralph” executes the following, then executes some SQL commands:

```
set proxy susie
```

sp_who returns “susie” for loginame and “ralph” for origname.

sp_who queries the master..sysprocesses system table, which contains columns for the server user ID (suid) and the original server user ID (origsuid).

For more information, see sp_who in the *Reference Manual: Procedures*.

Reporting permissions on database objects or users

Use sp_helprotect to report on permissions by database object or by user, and (optionally) by user for a specified object. Any user can execute this procedure. The syntax is:

```
sp_helprotect [name [, username [, "grant"
    [,"none"|"granted"|"enabled"|role_name]]]]
```

where:

- *name* – is either the name of the table, view, or stored procedure, or the name of a user, group, or role in the current database. If you do not provide a name, sp_helprotect reports on all permissions in the database.
- *username* – is a user's name in the current database.

  If you specify *username*, only that user's permissions on the specified object are reported. If *name* is not an object, sp_helprotect checks whether *name* is a user, group, or role and if it is, lists the permissions for the user, group, or role. If you specify the keyword grant, and *name* is not an object, sp_helprotect displays all permissions granted by with grant option.
- grant – displays the permissions granted to *name* with grant option.
- none – ignores roles granted to the user.
- granted – includes information on all roles granted to the user.
- enabled – includes information on all roles activated by the user.
- *role_name* – displays permission information for the specified role only, regardless of whether this role has been granted to the user.

For example, suppose you issue the following series of grant and revoke statements:

```
grant select on titles to judy
grant update on titles to judy
revoke update on titles(contract) from judy
grant select on publishers to judy
    with grant option
```

To determine the permissions Judy now has on each column in the titles table, enter:

```
sp_helprotect titles, judy
grantor grantee type   action   object     column      grantable
------- ------ -----   ------   ------     ------      -------
dbo     judy   Grant   Select   titles     All         FALSE
dbo     judy   Grant   Update   titles     advance     FALSE
dbo     judy   Grant   Update   titles     notes       FALSE
dbo     judy   Grant   Update   titles     price       FALSE
dbo     judy   Grant   Update   titles     pub_id      FALSE
dbo     judy   Grant   Update   titles     pubdate     FALSE
dbo     judy   Grant   Update   titles     title       FALSE
dbo     judy   Grant   Update   titles     title_id    FALSE
dbo     judy   Grant   Update   titles     total_sales FALSE
dbo     judy    Grant   Update   titles     type        FALSE
```

The first row shows that the database owner ("dbo") gave Judy permission to select all columns of the titles table. The rest of the lines indicate that she can update only the columns listed in the display. Judy cannot give select or update permissions to any other user.

To see Judy's permissions on the publishers table, enter:

```
sp_helprotect publishers, judy
```

In this display, the grantable column indicates TRUE, meaning that Judy can grant the permission to other users.

```
grantor grantee type   action   object     column      grantable
------- ------ -----   ------   ------     ------      -------
dbo     judy    Grant   Select  publishers   all         TRUE
```

Reporting permissions on specific tables

Use sp_table_privileges to return permissions information about a specified table. The syntax is:

sp_table_privileges *table_name* [, *table_owner*
  [, *table_qualifier*]]

where:

- *table_name* – is the name of the table, and is required.
- *table_owner* – can be used to specify the name of the table owner, if it is not "dbo" or the user executing sp_table_privileges.

- *table_qualifier* – is the name of the current database.

Use null for parameters that you want to skip.

For example, this statement returns information about all permissions granted on the titles table:

```
sp_table_privileges titles
```

For more information about the output of sp_table_privileges, see the *Reference Manual: Procedures*.

Reporting permissions on specific columns

Use sp_column_privileges to return information about permissions on columns in a table. The syntax is:

sp_column_privileges *table_name* [, *table_owner*
  [, *table_qualifier* [, *column_name*]]]

where:

- *table_name* – is the name of the table.
- *table_owner* – can be used to specify the name of the table owner, if it is not "dbo" or the user executing sp_column_privileges.
- *table_qualifier* – is the name of the current database.
- *column_name* – is the name of the column on which you want to see permissions information.

Use null for parameters that you want to skip.

For example, this statement returns information about the pub_id column of the publishers table:

```
sp_column_privileges publishers, null, null, pub_id
```

For more information about the output of sp_column_privileges, see the *Reference Manual: Procedures*.

Using views and stored procedures as security mechanisms

Views and stored procedures can serve as security mechanisms. You can give users controlled access to database objects via a view or stored procedure without granting them direct access to the data. For example, you might give a clerk execute permission on a procedure that updates cost information in a projects table without letting the user see confidential data in the table. To use this feature, you must own the procedure or view as well as its underlying objects. If you do not own the underlying objects, users must have permission to access the objects. For more information about when permissions are required, see "Understanding ownership chains" on page 210.

Adaptive Server makes permission checks, as required, when the view or procedure is used. When you create the view or procedure, Adaptive Server makes no permission checks on the underlying objects.

Using views as security mechanisms

Through a view, users can query and modify only the data they can see. The rest of the database is neither visible nor accessible.

Permission to access the view must be explicitly granted or revoked, regardless of the permissions on the view's underlying tables. If the view and underlying tables are owned by the same owner, no permissions need to be given on the underlying tables. Data in an underlying table that is not included in the view is hidden from users who are authorized to access the view but not the underlying table.

By defining different views and selectively granting permissions on them, a user (or any combination of users) can be restricted to different subsets of data. Access can be restricted to:

- A subset of the rows of a base table (a value-dependent subset). For example, you might define a view that contains only the rows for business and psychology books to keep information about other types of books hidden from some users.
- A subset of the columns of a base table (a value-independent subset). For example, you might define a view that contains all the rows of the titles table, but omits the price and advance columns, since this information is sensitive.
- A row-and-column subset of a base table.

- The rows that qualify for a join of more than one base table. For example, you might define a view that joins the titles, authors, and titleauthor tables. This view hides personal data about authors and financial information about the books.
- A statistical summary of data in a base table. For example, you might define a view that contains only the average price of each type of book.
- A subset of another view, or of some combination of views and base tables.

Let's say you want to prevent some users from accessing the columns in the titles table that display money and sales amounts. You can create a view of the titles table that omits those columns, and then give all users permission on the view but only the Sales Department permission on the table:

```
grant all on bookview to public
grant all on titles to sales
```

An equivalent way of setting up these privilege conditions, without using a view, is to use the following statements:

```
grant all on titles to public
revoke select, update on titles (price, advance,
    total_sales)
from public
grant select, update on titles (price, advance,
    total_sales)
to sales
```

One possible problem with the second solution is that users not in the sales group who enter the select * from titles command might be surprised to see the message that includes the phrase:

```
permission denied
```

Adaptive Server expands the asterisk into a list of all the columns in the titles table, and since permission on some of these columns has been revoked from nonsales users, access to these columns is denied. The error message lists the columns for which the user does not have access.

To see all the columns for which they do have permission, the nonsales users must name them explicitly. For this reason, creating a view and granting the appropriate permissions on it is a better solution.

You can also use views for **context-sensitive protection**. For example, you can create a view that gives a data entry clerk permission to access only those rows that he or she has added or updated. To do so, add a column to a table in which the user ID of the user entering each row is automatically recorded with a default. You can define this default in the create table statement, like this:

```
create table testtable
    (empid       int,
     startdate   datetime,
     username     varchar(30) default user)
```

Next, define a view that includes all the rows of the table where uid is the current user:

```
create view context_view
as
    select *
    from testtable
    where username = user_name()
with check option
```

The rows retrievable through this view depend on the identity of the person who issues the select command against the view. By adding with check option to the view definition, you make it impossible for any data entry clerk to falsify the information in the username column.

Using stored procedures as security mechanisms

If a stored procedure and all underlying objects are owned by the same user, that owner can grant users permission to use the procedure without granting permissions on the underlying objects. For example, you might give a user permission to execute a stored procedure that updates a row-and-column subset of a specified table, even though that user does not have any other permissions on that table.

Roles and stored procedures

Use the grant execute command to grant execute permission on a stored procedure to all users who have been granted a specified role. revoke execute removes this permission. But grant execute permission does not prevent users who do not have the specified role from being granted execute permission on the stored procedure.

For further security, you can restrict the use of a stored procedure by using the has_role system function within the procedure to guarantee that a procedure can be executed only by users who have a given role. has_role returns 1 if the user has a specific role (sa_role, sso_role, oper_role, or any user-defined role) and returns 0 if the user does not have that role. For example, here is a procedure that uses has_role to see if the user has the system administrator role:

```
create proc test_proc
as
if (has_role("sa_role") = 0)
begin
    print "You don't have the right role"
    return -1
end
else
    print "You have SA role"
    return 0
```

See "System Functions" in *Reference Manual: Building Blocks* for more information about has_role.

Understanding ownership chains

Views can depend on other views or tables. Procedures can depend on other procedures, views, or tables. These dependencies can be thought of as an ownership chain.

Typically, the owner of a view also owns its underlying objects (other views and tables), and the owner of a stored procedure owns all the procedures, tables, and views referenced by the procedure.

A view and its underlying objects are usually all in the same database, as are a stored procedure and all the objects it references; however, this is not required. If objects are in different databases, a user wanting to use the view or stored procedure must be a valid user or guest user in all of the databases containing the objects. This prevents users from accessing a database unless the database owner has authorized it.

When a user who has been granted execute permission on a procedure or view uses it, Adaptive Server does not check permissions on any of the underlying objects if:

- These objects and the view or procedure are owned by the same user, and
- The user accessing the view or procedure is a valid user or guest user in each of the databases containing the underlying objects.

However, if all objects are not owned by the same user, Adaptive Server checks object permissions when the ownership chain is broken. That is, if object A references object B, and B is not owned by the user who owns object A, Adaptive Server checks the permissions for object B. In this way, Adaptive Server allows the owner of the original data to retain control over who is authorized to access it.

Ordinarily, a user who creates a view needs to worry only about granting permissions on that view. For example, say Mary has created a view called auview1 on the authors table, which she also owns. If Mary grants select permission to Sue on auview1, Adaptive Server allows Sue to access it without checking permissions on authors.

However, a user who creates a view or stored procedure that depends on an object owned by another user must be aware that any permissions he or she grants depend on the permissions allowed by those other owners.

Example of views and ownership chains

Say Joe creates a view called auview2, which depends on Mary's view auview1. Joe grants Sue select permission on auview2.

Figure 6-2: Ownership chains and permission checking for views, case 1

Sue's permission	Objects	Ownership	Checks
select	*auview2*	Joe	Sue not owner Check permissions
select	*auview1*	Mary	Different owner Check permissions
none	*authors*	Mary	Same owner No permission check

Adaptive Server checks the permissions on auview2 and auview1, and finds that Sue can use them. Adaptive Server checks ownership on auview1 and authors and finds that they have the same owner. Therefore, Sue can use auview2.

Taking this example a step further, suppose that Joe's view, auview2, depends on auview1, which depends on authors. Mary decides she likes Joe's auview2 and creates auview3 on top of it. Both auview1 and authors are owned by Mary.

The ownership chain looks like this:

Figure 6-3: Ownership chains and permission checking for views, case 2

Sue's permission	Objects	Ownership	Checks
select	***auview3***	**Mary**	**Sue not owner Check permissions**
select	***auview2***	**Joe**	**Different owner Check permissions**
select	***auview1***	**Mary**	**Different owner Check permissions**
none	***authors***	**Mary**	**Same owner No permission check**

When Sue tries to access auview3, Adaptive Server checks permissions on auview3, auview2, and auview1. If Joe has granted permission to Sue on auview2, and Mary has granted her permission on auview3 and auview1, Adaptive Server allows the access. Adaptive Server checks permissions only if the object immediately before it in the chain has a different owner (or if it is the first object in the chain). For example, it checks auview2 because the object before it—auview3—is owned by a different user. It does not check permission on authors, because the object that immediately depends on it, auview1, is owned by the same user.

Example of procedures and ownership chains

Procedures follow the same rules as views. For example, suppose the ownership chain looks like this:

Figure 6-4: Ownership chains and permission checking for stored procedures

Sue's permission	Objects	Ownership	Checks
execute	***proc4***	**Mary**	**Sue not owner Check permissions**
none	***proc3***	**Mary**	**Same owner No permissions check**
execute	***proc2***	**Joe**	**Different owner Check permissions**
execute	***proc1***	**Mary**	**Different owner Check permissions**
none	***authors***	**Mary**	**Same owner No permission check**

To execute proc4, Sue must have permission to execute proc4, proc2, and proc1. Permission to execute proc3 is not necessary because proc3 and proc4 have the same owner.

Adaptive Server checks Sue's permissions on proc4 and all objects it references each time she executes proc4. Adaptive Server knows which referenced objects to check: it determined this the first time Sue executed proc4, and it saved the information with the procedure's execution plan. Unless one of the objects referenced by the procedure is dropped or redefined, Adaptive Server does not change its initial decision about which objects to check.

This protection hierarchy allows every object's owner to fully control access to the object. Owners can control access to views and stored procedures, as well as to tables.

Permissions on triggers

A **trigger** is a special kind of stored procedure used to enforce integrity, especially referential integrity. Triggers are never executed directly, but only as a side effect of modifying a table. You cannot grant or revoke permissions for triggers.

Only an object owner can create a trigger. However, the ownership chain can be broken if a trigger on a table references objects owned by different users. The protection hierarchy rules that apply to procedures also apply to triggers.

While the objects that a trigger affects are usually owned by the user who owns the trigger, you can write a trigger that modifies an object owned by another user. If this is the case, any users modifying your object in a way that activates the trigger must have permission on the other object as well.

If Adaptive Server denies permission on a data modification command because a trigger affects an object for which the user does not have permission, the entire data modification transaction is rolled back.

See Chapter 19, "Triggers: Enforcing Referential Integrity," in the *Transact-SQL User's Guide*.

Using row-level access control

Row-level access control enables the database owner or table owner to create a secure data access environment automatically, by providing:

- More granular data security: you can set permissions for individual rows, not just tables and columns
- Automatic data filtering according to group, role, and application
- Data-level security encoded in the server

Row-level access control restricts access to data in a table's individual rows, through three features:

- Access rules that the database owner defines and binds to the table
- Application Context Facility, which provides built-in functions that define, store, and retrieve user-defined contexts
- Login triggers that the database owner, sa_role, or the user can create

Adaptive Server enforces row-level access control for all data manipulation languages (DMLs), preventing users from bypassing the access control to get to the data.

The syntax for configuring your system for row-level access control is:

```
sp_configure "enable row level access", 1
```

This option slightly increases the amount of memory Adaptive Server uses, and you need an ASE_RLAC license option. Row-level access control is a dynamic option, so you need not restart Adaptive Server.

Access rules

To use the row-level access control feature, add the access option to the existing create rule syntax. Access rules restrict any rows that can be viewed or modified.

Access rules are similar to domain rules, which allow table owners to control the values users can insert or update on a column. The domain rule applies restrictions to added data, functioning on update and insert commands.

Access rules apply restrictions to retrieved data, enforced on select, update, and delete operations. Adaptive Server enforces the access rules on all columns that are read by a query, even if the columns are not included in the select list. In other words, in a given query, Adaptive Server enforces the domain rule on the table that is updated, and the access rule on all tables that are read.

For example:

```
insert into orders_table
select * from old_orders_table
```

In this query, if there are domain rules on the orders_table and access rules on the old_orders_table, Adaptive Server enforces the domain rule on the orders_table, because it is updated, and the access rule on the old_orders_table, because it is read.

Using access rules is similar to using views, or using an ad hoc query with where clauses. The query is compiled and optimized after the access rules are attached, so it does not cause performance degradation. Access rules provide a virtual view of the table data, the view depending on the specific access rules bound to the columns.

Access rules can be bound to user-defined datatypes, defined with sp_addtype. Adaptive Server enforces the access rule on user tables, which frees the table owner or database owner from the maintenance task of binding access rules to columns in the normalized schema. For instance, you can create a user-defined type, whose base type is varchar(30), call it username, and bind an access rule to it. Adaptive Server enforces the access rule on any tables in your application that have columns of type username.

Application developers can write flexible access rules using Java and application contexts, described in “Access rules as user-defined Java functions” on page 221, and “Using the Application Context Facility” on page 224.

Syntax for access rules

Use the access parameter in the create rule syntax to create access rules.

```
create [or|and] access rule (access_rule_name)
as (condition)
```

Creating a sample table with access rules

This section shows the process of creating a table and binding an access rule to it.

Creating a table

A table owner creates and populates table T (username char(30), title char(30), classified_data char(1024)):

```
AA, "Administrative Assistant","Memo to President"
AA, "Administrative Assistant","Tracking Stock
Movements"
VP1, "Vice President", "Meeting Schedule"
VP2, "Vice President", "Meeting Schedule"
```

Creating and binding access rules

The table owner creates access rule uname_acc_rule and binds it to the username column on table T.

```
create access rule uname_acc_rule
as @username = suser_name()
-----------
sp_bindrule uname_acc_rule, "T.username"
```

Querying the table

When you issue the following query:

```
select * from T
```

Adaptive Server processes the access rule that is bound to the username column on table T and attaches it to the query tree. The tree is then optimized and an execution plan is generated and executed, as though the user had executed the query with the filter clause given in the access rule. In other words, Adaptive Server attaches the access rule and executes the query as:

```
select * from T where T.username = suser_name().
```

The condition `where T.username = suser_name()` is enforced by the server. The user cannot bypass the access rule.

The result of an Administrative Assistant executing the select query is:

```
AA, "Administrative Assistant","Memo to President"
AA, "Administrative Assistant","Tracking Stock
Movements"
```

Dropping an access rule

Before you drop an access rule, you must unbind it from any columns or datatypes, using sp_unbindrule, as in the following example:

```
sp_unbindrule "T.username",
NULL, "all"
```

sp_unbindrule unbinds any domain rules attached to the column by default.

After you unbind the rule, you can drop it:

```
drop rule "rule_name"
```

For example:

```
drop rule "T.username"
```

Syntax for extended access rule

Each access rule is bound to one column, but you can have multiple access rules in a table. create rule provides AND and OR parameters to handle evaluating multiple access rules. To create AND access rules and OR access rules, use extended access rule syntax:

- AND access rule:

  create and access rule rule_name

- OR access rule

  create or access rule rule_name as

You can bind AND access rules and OR access rules to a column or user-defined datatype. With the extended access rule syntax, you can bind multiple access rules to the table, although you can bind only one per column. When the table is accessed, the access rules go into effect, the AND rules bound first by default, and then the OR access rules.

If you bind multiple access rules to a table without defining AND or OR access, the default access rule is AND.

If there is only one access rule on a row of the table and it is defined as an OR access rule, it behaves as an AND access rule.

Using access and extended access rules

Create access rules

The following steps create access rules:

```
create access rule empid1_access
as @empid = 1

create access rule deptno1_access
as @deptid = 2
```

The following steps create OR access rules:

```
create or access rule name1_access
as @name = "smith"

create or access rule phone_access
as @phone = "9999"
```

Create table

This step creates a test table:

```
create table testtab1 (empno int, deptno int,name
char(10), phone char(4))
```

Bind rules to table

The following steps bind access rules to the test table columns:

```
sp_bindrule empid1_access, "testtab1.empno"
/*Rule bound to table column.*/
(return status = 0)

sp_bindrule deptno1_access,"testtab1.deptno"
/*Rule bound to table column.*/

(return status = 0)

sp_bindrule name1_access,"testtab1.name"
/*Rule bound to table column.*/

(return status = 0)
```

```
sp_bindrule phone_access,"testtab1.phone"
/*Rule bound to table column.*/

(return status = 0)
```

Insert data into table

The following steps insert values into the test table:

```
insert testtab1 values (1,1,"smith","3245")
(1 row affected)

insert testtab1 values(2,1,"jones","0283")
(1 row affected)

insert testtab1 values(1,2,"smith","8282")(1 row
affected)

insert testtab1 values(2,2,"smith","9999")

(1 row affected)
```

Access rule examples

The following examples show how access rules return specific rows containing information limited by access rules.

Example 1 Returns information from two rows:

```
/* return rows when empno = 1 and deptno = 2
and ( name = "smith" or phone = "9999" )
*/

select * from testtab1
 empno        deptno       name        phone
------------ ----------- ---------- -----
             1           2 smith      8282
             1           2 jones      9999

(2 rows affected)

/* unbind access rule from specific column */
sp_unbindrule "testtab1.empno",NULL,"accessrule"
/*Rule unbound from table column.*/

(return status = 0)
```

Example 2 Returns information from four rows:

```
/* return rows when deptno = 2 and ( name = "smith"
or phone = "9999" )*/

select * from testtab1
```

```
 empno      deptno      name       phone
----------- ----------- ---------- -----
1           2           smith      8282
2           2           smith      9999
3           2           smith      8888
1           2           jones      9999

(4 rows affected)

/* unbind all deptno rules from specific column */
sp_unbindrule "testtab1.deptno",NULL,"all"
/*Rule unbound from table column.*/

(return status = 0)
```

Example 3 Returns information from six rows:

```
/* return the rows when name = "smith" or phone = "9999"
*/

select * from testtab1
 empno       deptno      name       phone
 ----------- ----------- ---------- -----
           1           1 smith      3245
           1           2 smith      8282
           2           2 smith      9999
           3           2 smith      8888
           1           2 jones      9999
           2           3 jones      9999
```

Access rules and alter table command

When the table owner uses the alter table command, Adaptive Server disables access rules during the execution of the command and enables them upon completion of the command. The access rules are disabled to avoid filtering the table data during the alter table command.

Access rules and *bcp*

Adaptive Server enforces access rules when data is copied out of a table using the bcp. Adaptive Server cannot disable access rules, as it does with alter table, because any user can use bcp who has select permission on the table.

For security purposes, the database owner should lock the table exclusively and disable access rules during bulk copy out. The lock disables access to other users while the access rules are disabled. The database owner should bind the access rules and unlock the table after the data has been copied.

Access rules as user-defined Java functions

Access rules can use user-defined Java functions. For example, you can use Java functions to write sophisticated rules using the profile of the application, the user logged in to the application, and the roles that the user is currently assigned for the application.

The following Java class uses the method GetSecVal to demonstrate how you can use Java methods that use JDBC as user-defined functions inside access rules:

```
import java.sql.*;
import java.util.*;

public class sec_class {
static String _url = "jdbc:sybase:asejdbc";
public static int GetSecVal(int c1)
{
try
{
PreparedStatement pstmt;
ResultSet rs = null;
Connection con = null;
    int pno_val;

pstmt = null;

Class.forName("sybase.asejdbc.ASEDriver");
con = DriverManager.getConnection(_url);

if (con == null)
{
return (-1);
}

pstmt = con.prepareStatement("select classification
from sec_tab where id = ?");

if (pstmt == null)
{
return (-1);
```

```
}

pstmt.setInt(1, c1);

rs = pstmt.executeQuery();

rs.next();

pno_val = rs.getInt(1);

rs.close();

pstmt.close();

con.close();

return (pno_val);

}
catch (SQLException sqe)
{
return(sqe.getErrorCode());
}
catch (ClassNotFoundException e)
{

System.out.println("Unexpected exception : " +
e.toString());
System.out.println("\nThis error usually indicates that
" + "your Java CLASSPATH environment has not been set
properly.");
e.printStackTrace();
return (-1);
}
catch (Exception e)
{
System.out.println("Unexpected exception : " +
e.toString());
e.printStackTrace();
return (-1);
}
}
}
```

After compiling the Java code, you can run the same program from isql, as follows.

For example:

```
javac sec_class.java
jar cufo sec_class. jar sec_class.class
installjava -Usa -Password -
f/work/work/FGAC/sec_class.jar -
-D testdb
```

From isql:

```
/*to create new user datatype class_level*/
sp_addtype class_level, int
/*to create the sample secure data table*/
create table sec_data (c1 varchar(30),
c2 varchar(30),
c3 varchar(30),
clevel class_level)
/*to create the classification table for each user*/
create table sec_tab (userid int, clevel class-level
int)

insert into sec_tab values (1,10)
insert into sec_tab values (2,9)
insert into sec_tab values (3,7)
insert into sec_tab values (4,7)
insert into sec_tab values (5,4)
insert into sec_tab values (6,4)
insert into sec_tab values (7,4)

declare @v1 int
select @v1 = 5
while @v1 > 0
begin
insert into sec_data values('8', 'aaaaaaaaaa',
'aaaaaaaaaa', 8)
insert into sec_data values('7', 'aaaaaaaaaa',
'aaaaaaaaaa', 7)
insert into sec_data values('5', 'aaaaaaaaaa',
'aaaaaaaaaa', 5)
insert into sec_data values('5', 'aaaaaaaaaa',
'aaaaaaaaaa', 5)
insert into sec_data values('2', 'aaaaaaaaaa',
'aaaaaaaaaa', 2)
insert into sec_data values('3', 'aaaaaaaaaa',
'aaaaaaaaaa', 3)
select @v1 = @v1 -1
end
go
```

```
create access rule clevel_rule
@clevel <= sec_class.GetSecVal(suser_id())
go

create default clevel_def as
sec_class.GetSecVal(suser_id())
go

sp_bindefault clevel_def, class_level
go

sp_bindrule clevel, class_level
go

grant all on sec_data to public
go
grant all on sec_tab to public
go
```

Using the Application Context Facility

Applications on a database server must limit access to the data. Applications are carefully coded to consider the profile of the user. For example, a Human Resources application is coded to know which users are allowed to update salary information.

The attributes that enable this coding comprise an application context. The Application Context Facility (ACF) consists of three built-in functions that provide a secure environment for data access, by allowing access rules to compare against the intrinsic values assigned to users in a session.

An application context consists of context_name, attribute_name, and attribute_value. Users define the context name, the attributes, and the values for each context. You can use the default read-only application context that Sybase provides, SYS_SESSION, to access some session-specific information. This application context is shown as Table 6-4 on page 230. You can also create your own application contexts, as described in "Creating and using application contexts" on page 226.

The user profile, combined with the application profile, which is defined in a table created by the system administrator, permits cumulative and overlapping security schemes.

ACF allows users to define, store, and retrieve:

- User profiles (the roles authorized to a user and the groups to which the user belongs)
- Application profiles currently in use

Any number of application contexts per session are possible, and any context can define any number of attribute/value pairs. ACF context rows are specific to a session, and not persistent across sessions; however, unlike local variables, they are available across nested levels of statement execution. ACF provides built-in functions that set, get, list, and remove these context rows.

Setting permissions for using application context functions

You execute an application context function in a select statement. The owner of the function is the system administrator of the server. You can create, set, retrieve, and remove application contexts using built-in functions.

The data used in the functions is defined in a table that contains all logins for all tables, which created by the system administrator. For more information about this table, see “Using login triggers” on page 232.

- set_appcontext() stores:

```
select set_appcontext ("titles", "rlac", "1")
```

- get_appcontext() supplies two parts of a context in a session, and retrieves the third:

```
select get_appcontext ("titles", "rlac")
------------------------
1
```

For more information on these functions and on list_appcontext and rm_appcontext, see “Creating and using application contexts” on page 226.

Granting and revoking

Grant and revoke privileges to users, roles, and groups in a given database to access objects in that database. The only exceptions are create database, set session authorization, and connect. A user granted these privileges should be a valid user in the master database. To use other privileges, the user must be a valid user in the database where the object is located.

Using of functions means that unless special arrangements are made, any logged-in user can reset the profiles of the session. Although Adaptive Server audits built-in functions, security may be compromised before the problem is noticed. To restrict access to these built-in functions, use grant and revoke privileges. Only users with the sa_role can grant or revoke privileges on the built-in functions. Only the select privilege is checked as part of the server-enforced data access control checks performed by the functions.

Valid users

Functions do not have an object ID and they do not have a home database. Therefore, each database owner must grant the select privilege for the functions to the appropriate user. Adaptive Server finds the user's default database and checks the permissions against this database. With this approach, only the owner of the users' default database needs to grant the select privilege. If other databases should be restricted, the owner of those databases must explicitly revoke permission from the user in those databases.

Only the application context built-in functions perform data access control checks on the user when you grant and revoke privileges on them. Granting or revoking privileges for other functions has no effect in Adaptive Server.

Privileges granted to public affect only users named in the table created by the system administrator. For information about the table, see "Using login triggers" on page 232. Guest users have privileges only if the sa_role specifically grants it by adding them to the table.

A system administrator can execute the following commands to grant or revoke select privileges on specific application context functions:

- grant select on set_appcontext to user_role
- grant select on set_appcontext to joe_user
- revoke select on set_appcontext from joe_user

Creating and using application contexts

The following functions are available for creating and maintaining application contexts. For more information, see *Reference Manual: Building Blocks*.

- set_appcontext
- get_appcontext
- list_appcontext
- rm_appcontext

set_appcontext

Sets an application context name, attribute name, and attribute value, defined by the attributes of an application, for a specified user session.

set_appcontext ("*context_name*", "*attribute_name*", "*attribute_value*")

Parameters

- *context_name* – a row that specifies an application context name, saved as the datatype char(30).
- *attribute_name* – a row that specifies an application context name, saved as the datatype char(30)
- *attribute_value* – a row that specifies an application attribute value, saved as the datatype char(255).

Examples

Example 1 Creates an application context called CONTEXT1, with an attribute ATTR1 that has the value VALUE1:

```
select set_appcontext ("CONTEXT1", "ATTR1", "VALUE1")
---------------
0
```

Example 2 Shows an attempt to override the existing application context. The attempt fails, returning -1:

```
select set_appcontext("CONTEXT1", "ATTR1", "VALUE1")
--------------
-1
```

Example 3 Shows how set_appcontext can include a datatype conversion in the value:

```
declare@val numeric
select @val = 20
select set_appcontext ("CONTEXT1", "ATTR2",
convert(char(20), @val))
------------
0
```

Example 4 Shows the result when a user without appropriate permissions attempts to set the application context. The attempt fails, returning -1:

```
select set_appcontext("CONTEXT1", "ATTR2", "VALUE1")
--------------
-1
```

Usage

- set_appcontext returns 0 for success and -1 for failure.
- If you set values that already exist in the current session, set_appcontext returns -1.
- set_appcontext cannot override the values of an existing application context. To assign new values to a context, remove the context and re-create it using the new values.

- set_appcontext saves attributes as char datatypes. If you create an access rule that must compare the attribute value to another datatype, the rule should convert the char data to the appropriate datatype.
- All arguments in this function are required.

get_appcontext

Returns the value of the attribute in a specified context.

get_appcontext ("*context_name*", "*attribute_name*")

Parameters

- *context_name* – a row specifying an application context name, saved as datatype char(30).
- *attribute_name* – a row specifying an application context attribute name, saved as datatype char(30).

Examples

Example 1 Shows VALUE1 returned for ATTR1:

```
select get_appcontext ("CONTEXT1", "ATTR1")
-----------
VALUE1
```

Example 2 ATTR1 does not exist in CONTEXT2:

```
select get_appcontext("CONTEXT2", "ATTR1")
------------
NULL
```

Example 3 Shows the result when a user without appropriate permissions attempts to get the application context:

```
select get_appcontext("CONTEXT1", "ATTR2")
select permisssion denied on built-in get_appcontext,
database dbid
----------
-1
```

Usage

- get_appcontext returns 0 for success and -1 for failure.
- If the attribute you require does not exist in the application context, get_appcontext returns “null.”
- get_appcontext saves attributes as char datatypes. If you create an access rule that compares the attribute value to other datatypes, the rule should convert the char data to the appropriate datatype.
- All arguments in this function are required.

list_appcontext

Lists all the attributes of all the contexts in the current session.

list_appcontext ("*context_name*")

Parameters

- *context_name* – names all the application context attributes in the session. list_appcontext has a datatype of char(30).

Examples

Example 1 Shows the results of a user with appropriate permissions listing the application contexts:

```
select list_appcontext ("*", "*")
Context Name: (CONTEXT1)
Attribute Name: (ATTR1) Value: (VALUE2)
Context Name: (CONTEXT2)
Attribute Name: (ATTR1) Value: (VALUE!)
-----------
0
```

Example 2 Shows a user without appropriate permissions attempting to list the application contexts. The attempt fails, returning -1.

```
select list_appcontext()
Select permission denied on built-in
list_appcontext, database DBID
---------
-1
```

Usage

- list_appcontext returns 0 for success and -1 for failure.
- Since built-in functions do not return multiple result sets, the client application receives list_appcontext returns as messages.

Permissions

To use list_appcontext, the user must have appropriate permissions. For more information, see “Setting permissions for using application context functions” on page 225.

rm_appcontext

Removes a specific application context, or all application contexts.

rm_appcontext ("*context_name*", "*attribute_name*")

Parameters

- *context_name* – a row specifying an application context name, saved as datatype char(30).
- *attribute_name* – a row specifying an application context attribute name, saved as datatype char(30).

Examples

Example 1 Uses an asterisk ("*") to remove all attributes in the specified context.

```
select rm_appcontext("CONTEXT1", "*")
---------
0
```

Example 2 Uses an asterisk ("*") to remove all the contexts and attributes.

```
select rm_appcontext("*", "*")
---------
0
```

Example 3 Shows a user attempting to remove a nonexistent context. The attempt fails, returning -1.

```
select rm_appcontext("NON_EXISTING_CTX", "ATTR2")
---------
-1
```

Example 4 Shows the result of a user without appropriate permissions attempting to remove an application context.

```
select rm_appcontext("CONTEXT1", "ATTR2")
---------
-1
```

Usage

- rm_appcontext returns 0 for success, -1 for failure.
- All arguments in this function are required.

SYS_SESSION system application context

The SYS_SESSION context shows the default predefined application context, which provides session-specific pairs of attributes and values. The syntax for using the context is:

select list_appcontext ("SYS_SESSION", "*")

Then:

```
select get_appcontext ("SYS_SESSION", "<attribute>")
```

Table 6-4: SYS_SESSION attributes and values

Attribute	Value
username	Login name
hostname	Host name from which the client has connected
applname	Name of the application as set by the client

Attribute	Value
suserid	User ID of the user in the current database
groupid	Group ID of the user in the current database
dbid	ID of the user's current database
dbname	Current database
spid	Server process ID
proxy_suserid	The server user ID of the proxy
client_name	Client name set by the middle-tier application, using set client_name
client_applname	Client application name set by the middle-tier application, using set client_applname
client_hostname	Client host name set by the middle-tier application, using set client_hostname
language	Current language the client is using by default or after using set language (@@language)
character_set	Character set the client is using (@@client_csname)
dateformat	Date expected by the client, set using set dateformat
is_showplan_on	Returns YES if set showplan is on, NO if it is off
is_noexec_on	Returns YES if set no exec is on, NO if it is off

Solving a problem using an access rule and ACF

This section shows the solution of a problem: each of five users, on different security levels, should see only rows with a value less than or equal to his or her security level. This solution uses access rules, with the Application Context Facility, to display only the rows that one of the users, Dave, sees.

There are five logins:

- Anne has security level 1.
- Bob has security level 1.
- Cassie has security level 2.
- Dave has security level 2.
- Ellie has security level 4.

Users should see only rows with a value in rlac that is less than or equal to their own security level. To accomplish this, create an access rule and apply ACF.

The rlac column is type integer, and appcontext arguments are type char.

```
create access rule rlac_rule as
  @value <= convert(int, get_appcontext("titles",
        "rlac"))
```

```
sp_bindrule rlac_rule, "titles.rlac"

/* log in as Dave and apply ACF value of 2*/

select set_appcontext("titles", "rlac", "2")

/*this value persists throughout the session*/
/*select all rows*/

select title_id, rlac from titles
--------------------
title_id     rlac
------------ --------
PC8888       1
BU1032       2
PS7777       1
PS3333       1
BU1111       2
PC1035       1
BU2075       2
PS2091       1
PS2106       1
BU7832       2
PS1372       1

(11 rows affected)
```

Using login triggers

Note Some information in this section is from the article "Login Triggers in ASE 12.5" at http://www.sypron.nl/logtrig.html. Copyright 1998–2002, Rob Verschoor/ Sypron B.V.

Login triggers execute a specified stored procedure every time a user logs in. The login trigger is an ordinary stored procedure, except it executes in the background. It is the last step in a successful login process, and sets the application context for the user logging in.

Only the system security officer can register a login trigger to users in the server.

To provide a secure environment, the system administrator must:

1. Revoke select privilege on the set_appcontext function. The owner of a login trigger must have explicit permission to use set_appcontext, even if the owner has sa_role.
2. Configure a login trigger from a stored procedure for each user, and register the login trigger to the user.
3. Provide execute privilege to the login trigger that the user executes.

Creating login triggers

Create a login trigger as a stored procedure. Do not use the create trigger command. The following sample requires the you first create the lookup table in the pubs2 database:

```
create table lookup (
  appname varchar(20),
  attr varchar(20),
  value varchar(20),
  login varchar(20)
)
```

Then create a login trigger stored procedure in the pubs2 database:

```
create procedure loginproc as
  declare @appnamevarchar(20)
  declare @attr varchar(20)
  declare @value varchar(20)
  declare @retvalue int
declare apctx cursor for
select appname, attr, value from
pubs2.dbo.lookup where login = suser_name()
open apctx
fetch apctx into @appname, @attr, @value

While (@@sqlstatus = 0)
  begin
    select f@retval =
      set_appcontext (rtrim (@appname),
      rtrim(@attr), rtrim(@value))
  fetch apctx into @appname, @attr, @value
 end
go
```

Grant permission to execute loginproc to public:

```
grant execute on loginproc to public
```

To associate the login trigger with a specific user, run alter login in the user's default database.

Configuring login triggers

You must have sso_role enabled to set, change, or drop a login trigger. The object ID of the login trigger is stored in the syslogins.procid column. Login triggers do not exist by default. They must be registered using alter login.

Run this command from the user's default database. The stored procedure you are registering as a login trigger must be available in the user's default database, because Adaptive Server searches the sysobjects table in the user's default database to find the login trigger object.

Configuring the login trigger

The following example configures the stored procedure my_proc (which must exist in the database you want to configure) as a login trigger for Adaptive Server login my_login:

```
alter login my_login modify login script "my_proc"
```

Again, you must execute the command from within the user's default database. Adaptive Server checks to see whether the login has execute permissions on the stored procedure, but not until the user actually logs in and executes the login trigger.

Dropping and changing the login trigger

Once you have configured a stored procedure as a login trigger, you cannot drop it. You must unconfigure it first, either by dropping the login trigger altogether, or by changing the login trigger to a different stored procedure. To drop the login trigger, enter:

```
alter login my_login drop login script
```

To change the login trigger to a different stored procedure, enter:

```
alter login my_login modify login script "diff_proc"
```

Displaying the login trigger

To display the current login trigger, use sp_displaylogin:

```
sp_displaylogin my_login
go
(....)
Default Database: my_db
Default Language:
Auto Login Script: my_proc
....
```

Executing a login trigger

Login triggers are different from ordinary stored procedures in that once they are registered they execute in the background, without active user connections. Once you have configured a login trigger, Adaptive Server automatically executes it in the background as soon as the user logs in, but before the server executes any commands from the client application.

If one login makes multiple concurrent connections, the login trigger executes independently during each session. Similarly, multiple logins can configure the same stored procedure to be a login trigger.

Background execution means that you cannot use some standard features of stored procedures in a stored procedure configured as a login trigger. For instance, you cannot pass any parameters without default values to or from the procedure, nor does the procedure pass back any result values.

This special execution mode affects any stored procedures that are called by the login trigger stored procedure, as well as any output generated by the login trigger stored procedure itself.

You can also execute a login trigger stored procedure as a normal stored procedure, for example, from isql. The procedure executes and behaves normally, showing all output and error messages as usual.

Understanding login trigger output

The main effect of executing the stored procedure as a background task is that output from the login trigger is not written to the client application, but to the Adaptive Server error log file, as are some, but not all, error messages.

Output from print or raiserror messages is prefixed by the words background task message or background task error in the error log. For example, the statements print "Hello!" and raiserror 123456 in a login trigger appear in the Adaptive Server error log as:

```
(....) background task message: Hello!
(....) background task error 123456: This is test
message 123456
```

However, not all output goes to the Adaptive Server error log:

- No result sets from select statements (which are normally sent to a client connection) appear anywhere, not even in the Adaptive Server error log. This information disappears.

- The following statements execute normally: insert...select and select...into statements, as well as other DML statements which do not ordinarily send a result set to the client application, and DDL statements ordinarily allowed in a stored procedure.

Using login triggers for other applications

Login triggers are part of the row-level access control feature in Adaptive Server. In this context, you can use a login trigger in combination with the features for access rules and application contexts to set up row-level access controls, once a session logs in to Adaptive Server. However, you can use login triggers for other purposes as well.

Limiting the number of concurrent connections

The following example limits the number of concurrent connections to Adaptive Server that a specific login can make. Each of the commands described in steps 1 and 2 in the example are executed in the default database of the user for whom the access needs to be restricted:

1. As system administrator, create the limit_user_sessions stored procedure:

```
create procedure limit_user_sessions
as
  declare @cnt int,
   @limit int,
   @loginname varchar(32)

  select @limit = 2 -- max nr. of concurrent logins

/* determine current #sessions */
select @cnt = count(*)
from master.dbo.sysprocesses
  where suid = suser_id()

/* check the limit */
if @cnt > @limit
begin
  select @loginname = suser_name()
  print "Aborting login [%1!]: exceeds session
    limit [%2!]",
      @loginname, @limit
    /* abort this session */
    select syb_quit()
end
go

grant exec on limit_user_sessions to public
```

```
go
```

2. As system security officer, configure this stored procedure as a login trigger for user "bob":

```
alter login bob modify login script
"limit_user_sessions"
go
```

3. Now, when user "bob" creates a third session for Adaptive Server, this session is terminated by the login trigger calling the syb_quit() function:

```
% isql -SASE125 -Ubob -Pbobpassword
1> select 1
2> go

CT-LIBRARY error:
ct_results(): network packet layer: internal net
library error: Net-Library operation terminated due
to disconnect
```

4. This message appears in the Adaptive Server error log file:

```
(...) background task message: Aborting login
[ my_login]: exceeds session limit [2]
```

Enforcing timed-based restrictions

This example describes how system administrators can create a login trigger to enforce time-based restrictions on user sessions. Each of the commands described in steps 1 – 4 are executed in the default database of the user for whom the access needs to be restricted:

1. As system administrator, create this table:

```
create table access_times (
suid int not null,
dayofweek tinyint,
shiftstart time,
shiftend time)
```

2. As system administrator, insert the following rows in table access_times. These rows indicate that user "bob" is allowed to log into Adaptive Server on Mondays between 9:00am and 5:00pm, and user "mark" is allowed to login to Adaptive Server on Tuesdays between 9:00am and 5:00pm.

```
insert into access_times
select suser_id('bob'), 1, '9:00', '17:00'
go
insert into access_times
select suser_id('mark'), 2, '9:00', '17:00'
go
```

3 As system administrator, create the limit_access_time stored procedure, which references the access_time table to determine if login access should be granted:

```
create procedure limit_access_time as
declare @curdate date,
    @curdow tinyint,
    @curtime time,
    @cnt int,
    @loginname varchar(32)

-- setup variables for current day-of-week, time
select @curdate = current_date()
select @curdow = datepart(cdw,@curdate)
select @curtime = current_time()
select @cnt = 0

-- determine if current user is allowed access
select @cnt = count(*)
from access_times
where suid = suser_id()
and dayofweek = @curdow
and @curtime between shiftstart and shiftend

if @cnt = 0
begin
   select @loginname = suser_name()
   print "Aborting login [%1!]: login attempt past
     normal working hours", @loginname

   -- abort this session
   return -4
end
go

grant exec on limit_access_time to public
go
```

4 As system security officer, configure the limit_access_time stored procedure as a login trigger for users “bob” and “mark”:

```
alter login bob login script
"limit_access_time"
go
alter login mark login script
"limit_access_time"
go
```

5 On Mondays, user “bob” can successfully create a session:

```
isql -Ubob -Ppassword
1> select 1
2> go
-----------
          1
(1 row affected)
```

However, user “mark” is denied access to Adaptive Server:

```
isql -Umark -Ppassword
1> select 1
2> go
CT-LIBRARY error:
ct_results(): network packet layer: internal net
library error: Net-Library operation terminated
due to disconnect
```

6 The following message is logged in the error log:

```
(...) server back-ground task message: Aborting
login [mark]: login attempt past normal working
hours
```

The above examples show how you can limit the number of concurrent connections for a specific login and restrict access to specific times of day for that login, but it has one disadvantage: the client application cannot easily detect the reason the session was terminated. To display a message to the user, such as “Too many users right now—please try later,” use a different approach.

Instead of calling the built-in function syb_quit(), which causes the server to simply terminate the current session, you can deliberately cause an error in the stored procedure to abort the login trigger stored procedure.

For example, dividing by zero aborts the login trigger stored procedure, terminates the session, and causes a message to appear.

Login trigger restrictions

The following actions are restricted.

- You cannot create #temp tables to use later in the session. Once the procedure completes, #temp tables are automatically dropped and the original session settings are restored, as in any other stored procedure.
- Do not use login triggers on the sa login; a failing login trigger can lock you out of Adaptive Server.

- Do not use a login trigger for anything that may take longer than a few seconds to process, or that risks processing problems.

Issues and information

- If you do not have access to the Adaptive Server error log, do not use login triggers. Always check the Adaptive Server error log for error messages.
- For Adaptive Server version 15.0.2 and later, any exportable option set or unset in a login trigger take effect in the login process when the server starts.

  To disable this behavior, execute set export_options off inside the login trigger.

  Adaptive Server versions 15.0.1, 12.5.4, and earlier required that you start Adaptive Server with trace flag 4073 to enable the options for a login trigger.
- A client application, like isql, is unaware of the existence or execution of a login trigger; it presents a command prompt immediately after the successful login, though Adaptive Server does not execute any commands before the login trigger successfully executes. This isql prompt displays even if the login trigger has terminated the user connection.
- The user logging in to Adaptive Server must have execute permission to use the login trigger stored procedure. If no execute permission has been granted, an error message appears in the Adaptive Server error log and the user connection closes immediately (though isql still shows a command prompt).

  Adaptive Server error log shows a message similar to the following:

  ```
  EXECUTE permission denied on object my_proc,
  database my_db, owner dbo
  ```
- The login trigger stored procedure cannot contain parameters without specified default values. If parameters without default values appear in the stored procedure, the login trigger fails and an error similar to the following appears in the Adaptive Server error log:

  ```
  Procedure my_proc expects parameter @param1, which
  was not supplied...
  ```

Disabling execute privilege on login triggers

A database owner or administrator can disable execute privilege on the login trigger, or code the login trigger to permit access only at certain times. For example, you may want to prohibit regular users from using the server while the database owner or administrator is updating the table.

Note If the login trigger returns a negative number, the login fails.

Exporting set options from a login trigger

Adaptive Server allows options for the set command that are inside login triggers to remain valid for the entire user session.

The following set options are automatically exported:

- showplan
- arithabort [overflow | numeric_truncation]
- arithignore [overflow]
- colnames
- format
- statistics io
- procid
- rowcount
- altnames
- nocount
- quoted_identifier
- forceplan
- fmtonly
- close on endtran
- fipsflagger
- self_recursion
- ansinull

- dup_in_subquery
- or_strategy
- flushmessage
- ansi_permissions
- string_rtruncation
- prefetch
- triggers
- replication
- sort_resources
- transactional_rpc
- cis_rpc_handling
- strict_dtm_enforcement
- raw_object_serialization
- textptr_parameters
- remote_indexes
- explicit_transaction_required
- statement_cache
- command_status_reporting
- proc_return_status
- proc_output_params

Setting global login triggers

Use sp_logintrigger to set a global login trigger that is executed at each user login. To take user-specific actions, set a user specific login trigger using alter login or create login.

Note You can activate this option by setting trace flag -T4073.

CHAPTER 7 Confidentiality of Data

This chapter describes how to configure Adaptive Server to ensure that all data is secure and confidential.

Secure Sockets Layer (SSL) in Adaptive Server

Adaptive Server Enterprise security services now support Secure Sockets Layer (SSL) session-based security. **SSL** is the standard for securing the transmission of sensitive information, such as credit card numbers, stock trades, and banking transactions, over the Internet.

While a comprehensive discussion of public-key cryptography is beyond the scope of this document, the basics are worth describing so that you have an understanding of how SSL secures Internet communication channels. This document is not a comprehensive guide to public-key cryptography.

The implementation of Adaptive Server SSL features assume that there is a knowledgeable system security officer who is familiar with the security policies and needs of your site, and who has general understanding of SSL and public-key cryptography.

Internet communications overview

TCP/IP is the primary transport protocol used in client/server computing, and is the protocol that governs the transmission of data over the Internet. TCP/IP uses intermediate computers to transport data from sender to recipient. The intermediate computers introduce weak links to the communication system where data may be subjected to tampering, theft, eavesdropping, and impersonation.

Public-key cryptography

Several mechanisms, known collectively as **public-key cryptography**, have been developed and implemented to protect sensitive data during transmission over the Internet. Public-key cryptography consists of encryption, key exchange, digital signatures, and digital certificates.

Encryption

Encryption is a process wherein a cryptographic algorithm is used to encode information to safeguard it from anyone except the intended recipient. There are two types of keys used for encryption:

- **Symmetric-key encryption** – is where the same algorithm (key) is used to encrypt and decrypt the message. This form of encryption provides minimal security because the key is simple, and therefore easy to decipher. However, transfer of data that is encrypted with a symmetric key is fast because the computation required to encrypt and decrypt the message is minimal.
- **Public/private key encryption** – also known as asymmetric-key, is a pair of keys that are made up of public and private components to encrypt and decrypt messages. Typically, the message is encrypted by the sender with a private key, and decrypted by the recipient with the sender’s public key, although this may vary. You can use a recipient’s public key to encrypt a message, who then uses his private key to decrypt the message.

  The algorithms used to create public and private keys are more complex, and therefore harder to decipher. However, public/private key encryption requires more computation, sends more data over the connection, and noticeably slows data transfer.

Key exchange

The solution for reducing computation overhead and speeding transactions without sacrificing security is to use a combination of both symmetric key and public/private key encryption in what is known as a key exchange.

For large amounts of data, a symmetric key is used to encrypt the original message. The sender then uses either his private key or the recipient's public key to encrypt the symmetric key. Both the encrypted message and the encrypted symmetric key are sent to the recipient. Depending on what key was used to encrypt the message (public or private) the recipient uses the opposite to decrypt the symmetric key. Once the key has been exchanged, the recipient uses the symmetric key to decrypt the message.

Digital signatures

Digital signatures are used for tamper detection and non-repudiation. Digital signatures are created with a mathematical algorithm that generates a unique, fixed-length string of numbers from a text message; the result is called a hash or message digest.

To ensure message integrity, the message digest is encrypted by the signer's private key, then sent to the recipient along with information about the hashing algorithm. The recipient decrypts the message with the signer's public key. This process also regenerates the original message digest. If the digests match, the message proves to be intact and tamper free. If they do not match, the data has either been modified in transit, or the data was signed by an imposter.

Further, the digital signature provides **non-repudiation**—senders cannot deny, or repudiate, that they sent a message, because their private key encrypted the message. Obviously, if the private key has been compromised (stolen or deciphered), the digital signature is worthless for non-repudiation.

Digital certificates

Digital Certificates are like passports: once you have been assigned one, the authorities have all your identification information in the system. Like a passport, the certificate is used to verify the identity of one entity (server, router, Web sites, and so on) to another.

Adaptive Server uses two types of certificates:

- **Server certificates** – a server certificate authenticates the server that holds it. Certificates are issued by a trusted third-party Certificate Authority (CA). The CA validates the holder's identity, and embeds the holder's public key and other identification information into the digital certificate. Certificates also contain the digital signature of the issuing CA, verifying the integrity of the data contained therein and validating its use.
- **CA certificates** (also known as **trusted root certificates) –** is a list of trusted CAs loaded by the server at start-up. CA certificates are used by servers when they function as a client, such as during remote procedure calls (RPCs). Adaptive Server loads its CA trusted root certificate at start-up. When connecting to a remote server for RPCs, Adaptive Server verifies that the CA that signed the remote server's certificate is a "trusted" CA listed in its own CA trusted roots file. If it is not, the connection fails.

Certificates are valid for a period of time and can be revoked by the CA for various reasons, such as when a security breach has occurred. If a certificate is revoked during a session, the session connection continues. Subsequent attempts to login fail. Likewise, when a certificate expires, login attempts fail.

The combination of these mechanisms protect data transmitted over the Internet from eavesdropping and tampering. These mechanisms also protect users from impersonation, where one entity pretends to be another (spoofing), or where a person or an organization says it is set up for a specific purpose when the real intent is to capture private information (misrepresentation).

SSL overview

SSL is an industry standard for sending wire- or socket-level encrypted data over secure network connections.

Before the SSL connection is established, the server and the client exchange a series of I/O round trips to negotiate and agree upon a secure encrypted session. This is called the SSL handshake.

SSL handshake

When a client requests a connection, the SSL-enabled server presents its certificate to prove its identity before data is transmitted. Essentially, the handshake consists of the following steps:

- The client sends a connection request to the server. The request includes the SSL (or Transport Layer Security, TLS) options that the client supports.
- The server returns its certificate and a list of supported cipher suites, which includes SSL/TLS support options, algorithms used for key exchange, and digital signatures.
- A secure, encrypted session is established when both client and server have agreed upon a CipherSuite.

For more specific information about the **SSL handshake** and the SSL/TLS protocol, see the Internet Engineering Task Force Web site at http://www.ietf.org.

For a list of cipher suites that Adaptive Server supports, see “Cipher Suites” on page 256.

SSL in Adaptive Server

Adaptive Server’s implementation of SSL provides several levels of security.

- The server authenticates itself—proves that it is the server you intended to contact—and an encrypted SSL session begins before any data is transmitted.
- Once the SSL session is established, the client requesting a connection can send his user name and password over the secure, encrypted connection.
- A comparison of the digital signature on the server certificate can determine whether the data received by the client was modified before reaching the intended recipient.

On most platforms, Adaptive Server uses SSL Plus(TM) library API from Certicom Corp. However, for Windows Opteron X64, Adaptive Server uses OpenSSL as the SSL provider.

SSL filter

The Adaptive Server directory service, such as the *interfaces* file, Windows Registry, or LDAP service, defines the server address and port numbers, and determines the security protocols that are enforced for client connections. Adaptive Server implements the SSL protocol as a filter that is appended to the master and query lines of the directory services.

The addresses and port numbers on which Adaptive Server accepts connections are configurable, so you can enable multiple network and security protocols for a single server. Server connection attributes are specified with directory services, such as LDAP, or with the traditional Sybase *interfaces* file. See “Creating server directory entries” on page 253.

All connection attempts to a master or query entry in the *interfaces* file with an **SSL filter** must support the SSL protocol. A server can be configured to accept SSL connections and have other connections that accept clear text (unencrypted data), or use other security mechanisms.

For example, the *interfaces* file on UNIX that supports both SSL-based connections and clear-text connections looks like this:

```
SYBSRV1
master tcp ether myhostname myport1 ssl
query    tcp ether myhostname myport1 ssl
master tcp ether myhostname myport2
```

The SSL filter is different from other security mechanisms, such Kerberos, which are defined with SECMECH (security mechanism) lines in the *interfaces* file (*sql.ini* on Windows).

Authentication via the certificate

The SSL protocol requires server authentication via a server certificate to enable an encrypted session. Likewise, when Adaptive Server is functioning as a client during RPCs, there must be a repository of trusted CAs that a client connection can access to validate the server certificate.

The server certificate

Each Adaptive Server must have its own server certificate file that is loaded at start-up. The following is the default location for the certificates file, where *servername* is the name of the Adaptive Server as specified on the command line during start-up with the -s flag, or from the environment variable *$DSLISTEN*:

- UNIX – *$SYBASE/$SYBASE_ASE/certificates/servername.crt*
- Windows – *%SYBASE%\%SYBASE_ASE%\certificates\servername.crt*

The server certificate file consists of encoded data, including the server's certificate and the encrypted private key for the server certificate.

Alternatively, you can specify the location of the server certificate file when using sp_ssladmin.

Note To make a successful client connection, the common name in the certificate must match the Adaptive Server name in the *interfaces* file.

The CA trusted roots certificate

The list of trusted CAs is loaded by Adaptive Server at start-up from the trusted roots file. The trusted roots file is similar in format to a certificate file, except that it contains certificates for CAs known to Adaptive Server. A trusted roots file is accessible by the local Adaptive Server in the following, where *servername* is the name of the server:

- UNIX – *$SYBASE/$SYBASE_ASE/certificates/servername.txt*
- Windows – *%SYBASE%\%SYBASE_ASE\certificates\servername.txt*

The trusted roots file is only used by Adaptive Server when it is functioning as a client, such as when performing RPC calls or Component Integration Services (CIS) connections.

The system security officer adds and deletes CAs that are to be accepted by Adaptive Server, using a standard ASCII-text editor.

Warning! Use the system security officer role (sso_role) within Adaptive Server to restrict access and execution on security-sensitive objects.

Adaptive Server provides tools to generate a certificate request and to authorize certificates. See "Using Adaptive Server tools to request and authorize certificates" on page 252.

Connection types

This section describes various client-to-server and server-to-server connections.

Client login to Adaptive Server

Open Client applications establish a socket connection to Adaptive Server similarly to the way that existing client connections are established. Before any user data is transmitted, an SSL handshake occurs on the socket when the network transport-level connect call completes on the client side and the accept call completes on the server side.

Server-to-server remote procedure calls

Adaptive Server establishes a socket connection to another server for RPCs in the same way that existing RPC connections are established. Before any user data is transmitted, an SSL handshake occurs on the socket when the network transport-level connect call completes. If the server-to-server socket connection has already been established, the existing socket connection and security context is reused.

When functioning as a client during RPCs, Adaptive Server requests the remote server's certificate during connection. Adaptive Server then verifies that the CA that signed the remote server's certificate is trusted; that is to say, on its own list of trusted CAs in the trusted roots file. It also verifies that the common name in the server certificate matches the common name used when establishing the connection.

Companion server and SSL

You can use a companion server to configure Adaptive Server for failover. You must configure both the primary and secondary servers with the same SSL and RPC configuration. When connections fail over or fail back, security sessions are reestablished with the connections.

Open Client connections

Component Integration Services, RepAgent, Distributed Transaction Management, and other modules in Adaptive Server use Client-Library to establish connections to servers other than Adaptive Server. The remote server is authenticated by its certificate. The remote server authenticates the Adaptive Server client connection for RPCs with user name and password.

Enabling SSL

Adaptive Server determines which security service it will use for a port based on the interface file (*sql.ini* on Windows).

❖ Enabling SSL

1. Generate a certificate for the server.
2. Create a trusted roots file.
3. Use sp_configure to enable SSL. From a command prompt, enter:

   ```
   sp_configure "enable ssl", 1
   ```

   - 1 – enables the SSL subsystem at start-up, allocates memory, and SSL performs wire-level encryption of data across the network.
   - 0 (the default) – disables SSL. This value is the default.
4. Add the SSL filter to the *interfaces* file. See “Creating server directory entries” on page 253.
5. Use sp_ssladmin to add a certificate to the certificates file. See “Administering certificates” on page 253.
6. Shut down and restart Adaptive Server.

Note To request, authorize, and convert third-party certificates, see the *Utility Guide* for information on the certauth, certreq, and certpk12 tools.

Unlike other security services, such Kerberos, and NTLAN, SSL relies neither on the “Security” section of the Open Client/Open Server configuration file *libtcl.cfg*, nor on objects in *objectid.dat*.

The system administrator should consider memory use by SSL when planning for total physical memory. You need approximately 40K per connection (connections include user connections, remote servers, and network listeners) in Adaptive Server for SSL connections. The memory is reserved and preallocated within a memory pool and is used internally by Adaptive Server and SSL Plus libraries as requested.

Obtaining a certificate

The system security officer installs server certificates and private keys for Adaptive Server by:

- Using third-party tools provided with existing public-key infrastructure already deployed in the customer environment.
- Using the Adaptive Server certificate request tool in conjunction with a trusted third-party CA.

To obtain a certificate, you must request a certificate from a certificate authority (CA). Adaptive Server requires SSL certificates to use the PEM format. However, the certificate authority may deliver certificates in a format other than PEM. You must convert the certificate to the PEM format If you request a certificate from a third party and that certificate is in PKCS #12 format, use the certpk12 utility to convert the certificate into a format that is understood by Adaptive Server (see the *Utility Guide*).

To test the Adaptive Server certificate request tool and to verify that the authentication methods are working on your server, Adaptive Server provides a tool, for testing purposes, that allows you to function as a CA and issue CA-signed certificate to yourself.

The main steps to creating a certificate for use with Adaptive Server are:

1. Generate the public and private key pair.
2. Securely store the private key.
3. Generate the certificate request.
4. Send the certificate request to the CA.
5. After the CA signs and returns the certificate, store it in a file and append the private key to the certificate.
6. Store the certificate in the Adaptive Server installation directory.

Third-party tools to request certificates

Most third-party PKI vendors and some browsers have utilities to generate certificates and private keys. These utilities are typically graphical wizards that prompt you through a series of questions to define a distinguished name and a common name for the certificate.

Follow the instructions provided by the wizard to create certificate requests. Once you receive the signed PKCS #12-format certificate, use certpk12 to generate a certificate file and a private key file. Concatenate the two files into a *servername.crt* file, where *servername* is the name of the server, and place it in the *certificates* directory under *$SYBASE/$SYBASE_ASE*. See the *Utility Guide*.

Using Adaptive Server tools to request and authorize certificates

Adaptive Server provides two tools for requesting and authorizing certificates. certreq generates public and private key pairs and certificate requests. certauth converts a server certificate request to a CA-signed certificate.

Warning! Use certauth only for testing purposes. Sybase recommends that you use the services of a commercial CA because it provides protection for the integrity of the root certificate, and because a certificate that is signed by a widely accepted CA facilitates the migration to the use of client certificates for authentication.

Preparing the server's trusted root certificate is a five-step process. Perform the first two steps to create a test trusted root certificate so you can verify that you are able to create server certificates. Once you have a test CA certificate (trusted roots certificate) repeat steps three through five to sign server certificates.

1. Use certreq to request a certificate.
2. Use certauth to convert the certificate request to a CA self-signed certificate (trusted root certificate).
3. Use certreq to request a server certificate and private key.
4. Use certauth to convert the certificate request to a CA-signed server certificate.
5. Append the private key text to the server certificate and store the certificate in the server's installation directory.

Note Adaptive Server includes the openssl open source utility in *$SYBASE/$SYBASE_OCS/bin*. Use openssl to accomplish all certificate management tasks implemented by certreq, certauth and certpk12. Sybase includes this binary as a convenience, and is not responsible for any issues incured using the binary. See www.openssl.org for details.

For information about Sybase utilities, certauth, certreq, and certpk12 for requesting, authorizing and converting third-party certificates, see the *Utility Guide*.

Note certauth and certreq are dependent on RSA and DSA algorithms. These tools only work with crypto modules that use RSA and DSA algorithms to construct the certificate request.

Creating server directory entries

Adaptive Server accepts client logins and server-to-server RPCs. The address and port numbers where Adaptive Server accepts connections are configurable so you can specify multiple networks, different protocols, and alternate ports.

In the *interfaces* file, SSL is specified as a filter on the master and query lines, whereas security mechanisms such as Kerberos are identified with a SECMECH line. The following example shows a TLI-based entry for an Adaptive Server using SSL in a UNIX environment:

An entry for the server with SSL and Kerberos security mechanisms on Windows might look like:

```
[SYBSRV2]
    query=nlwnsck, 18.52.86.120,2748,ssl
    master=nlwnsck 18.52.86.120,2748,ssl
    master=nlwnsck 18.52.86.120,2749
    secmech=1.3.6.1.4.897.4.6.6
```

The SECMECH line for SYBSRV2 in the example contains an object identifier (OID) that refers to the security mechanism Kerberos, respectively. The OID values are defined in:

- UNIX – *$SYBASE/$SYBASE_OCS/config/objectid.dat*
- Windows – *%SYBASE%\%SYBASE_OCS\ini\objectid.dat*

In these examples, the SSL security service is specified on port number 2748(0x0abc).

Note The use of SSL concurrently with a SECMECH security mechanism is intended to facilitate migration from SECMECHs to SSL security.

Administering certificates

To administer SSL and certificates in Adaptive Server, use sp_ssladmin. sso_role is required to execute the stored procedure.

sp_ssladmin is used to:

- Add local server certificates. You can add certificates and specify the password used to encrypt private keys, or require input of the password at the command line during start-up.
- Delete local server certificates.

- List server certificates.

The syntax for sp_ssladmin is:

sp_ssladmin {[addcert, *certificate_path* [, *password*|*NULL*]]
[dropcert, *certificate_path*]
[lscert]
[help]}
[lsciphers]
[setciphers, {"FIPS" | "Strong" | "Weak" | "All"
| *quoted_list_of_ciphersuites*}]

For example:

```
sp_ssladmin addcert, "/sybase/ASE-12_5/certificates/Server1.crt",
      "mypassword"
```

This adds an entry for the local server, *Server1.crt*, in the certificates file in the absolute path to */sybase/ASE-12_5/certificates* (*x:\sybase\ASE-12_5\certificates* on Windows). The private key is encrypted with the password "*mypassword*". The password should be the one specified when you created the private key.

Before accepting the certificate, sp_ssladmin verifies that:

- The private key can be decrypted using the provided password (except when NULL is specified).
- The private key and public key in the certificate match.
- The certificate chain, from root CA to the server certificate, is valid.
- The common name in the certificate matches the common name in the *interfaces* file.

If the common names do not match, sp_ssladmin issues a warning. If the other criteria fails, the certificate is not added to the certificates file.

Warning! Adaptive Server limits passwords to 64 characters. In addition, certain platforms restrict the length of valid passwords when creating server certificates. Select a password within these limits:

- Sun Solaris – both 32- and 64-bit platforms, 256 characters.
- Linux – 128 characters.
- IBM – both 32- and 64-bit platforms, 32 characters.
- HP – both 32- and 64-bit platforms, 8 characters.
- Windows – 256 characters.

The use of NULL as the password is intended to protect passwords during the initial configuration of SSL, before the SSL-encrypted session begins. Since you have not yet configured SSL, the password travels unencrypted over the connection. You can avoid this by specifying the password as NULL during the first login.

When NULL is the password, you must start dataserver with a -y flag, which prompts the administrator for the private-key password at the command line.

After restarting Adaptive Server with an SSL connection established, use sp_ssladmin again, this time using the actual password. The password is then encrypted and stored by Adaptive Server. Any subsequent starts of Adaptive Server from the command line use the encrypted password; you do not have to specify the password on the command line during start-up.

An alternative to using a NULL password during the first login is to avoid a remote connection to Adaptive Server via isql. You can specify "localhost" as the *hostname* in the *interfaces* file (*sql.ini* on Windows) to prevent clients from connecting remotely. Only a local connection can be established, and the password is never transmitted over a network connection.

Note Adaptive Server has sufficient memory in its network memory pool to allow sp_ssladmin addcert to set the certificate and private key password with its default memory allocations. However, if another network memory consumer has already allocated the default network memory, sp_ssladmin may fail and display this error to the client:

```
Msg 12823, Level 16, State 1:
Server 'servername', Procedure 'sp_ssladmin', Line 72:
Command 'addcert' failed to add certificate path
/work/REL125/ASE-12_5/certificates/servername.crt,
system error: ErrMemory.
(return status = 1)
```

Or the following message may appear in the error log:

```
 ... ssl_alloc: Cannot allocate using
ubfalloc(rnetmempool, 131072)
```

As a workaround, you can increase the additional network memory configuration parameter. Adaptive Server needs about 500K bytes of memory for sp_ssladmin addcert to succeed, so increasing additional network memory by this amount may allow it to succeed. This memory is reused by the network memory pool when needed, or you can return additional network memory to its previous value after sp_ssladmin has successfully completed.

Performance

There is additional overhead required to establish a secure session, because data increases in size when it is encrypted, and it requires additional computation to encrypt or decrypt information. The additional memory requirements for SSL increases the overhead by 50-60 percent for network throughput or for establishing a connection. You must have approximately 40K more memory for each user connection.

Cipher Suites

During the SSL handshake, the client and server negotiate a common security protocol via a CipherSuite. **Cipher Suites** are preferential lists of key-exchange algorithms, hashing methods, and encryption methods used by SSL-enabled applications. For a complete description of Cipher Suites, visit the Internet Engineering Task Force (IETF) organization at http://www.ietf.org/rfc/rfc2246.txt.

By default, the strongest CipherSuite supported by both the client and the server is the CipherSuite that is used for the SSL-based session.

Adaptive Server supports the Cipher Suites that are available with the SSL Plus library API and the cryptographic engine, Security Builder™, both from Certicom Corp.

Note The Cipher Suites listed conform to the Transport Layer Specification (TLS). TLS is an enhanced version of SSL 3.0, and is an alias for the SSL version 3.0 Cipher Suites.

@@ssl_ciphersuite

The Transact-SQL global variable *@@ssl_ciphersuite* allows users to know which cipher suite was chosen by the SSL handshake and verify that an SSL or a non-SSL connection was established.

Adaptive Server sets *@@ssl_ciphersuite* when the SSL handshake completes. The value is either NULL, indicating a non-SSL connection, or a string containing the name of the cipher suite chosen by the SSL handshake.

For example, an isql connection using SSL protocol displays the cipher suite chosen for it.

```
1> select @@ssl_ciphersuite
```

```
2> go
```

Output:

```
------------------------------
TLS_RSA_WITH_AES_128_CBC_SHA

(1 row affected)
```

Setting SSL cipher suite preferences

In Adaptive Server, sp_ssladmin has two command options to display and set cipher suite preferences: lsciphers and setciphers. With these options, the set of cipher suites that Adaptive Server uses can be restricted, giving control to the system security officer over the kinds of encryption algorithms that may be used by client connections to the server or outbound connections from Adaptive Server. The default behavior for use of SSL cipher suites in Adaptive Server is the same as in earlier versions; it uses an internally defined set of preferences for cipher suites.

To display the values for any set cipher suite preferences, enter:

```
sp_ssladmin lsciphers
```

To set a specific cipher suite preference, enter:

```
sp_ssladmin setciphers, {"FIPS" | "Strong" | "Weak" |
"All" | quoted_list_of_ciphersuites }
```

where:

- "FIPS" – is the set of encryptions, hash, and key exchange algorithms that are FIPS-compliant. The algorithms included in this list are AES, 3DES, DES, and SHA1.
- "Strong" – is the set of encryption algorithms using keys longer than 64 bits.
- "Weak" – is the set of encryption algorithms from the set of all supported cipher suites that are not included in the strong set.
- "All" – is the set of default cipher suites.
- quoted_list_of_ciphersuites – specifies a set of cipher suites as a comma-separated list, ordered by preference. Use quotes (") to mark the beginning and end of the list. The quoted list can include any of the predefined sets as well as individual cipher suite names. Unknown cipher suite names cause an error to be reported, and no changes are made to preferences.

The detailed contents of the predefined sets are in Table 7-1 on page 259.

sp_ssladmin setciphers sets cipher suite preferences to the given ordered list. This restricts the available SSL cipher suites to the specified set of "FIPS", "Strong", "Weak", "All", or a quoted list of cipher suites. This takes effect on the next listener started, and requires that you restart Adaptive Server to ensure that all listeners use the new settings.

You can display any cipher suite preferences that have been set using sp_ssladmin lsciphers. If no preferences have been set, sp_ssladmin lsciphers returns 0 rows to indicate no preferences are set and Adaptive Server uses its default (internal) preferences.

Table 7-1: Predefined cipher suites in Adaptive Server

Set name	Cipher suite names included in the set
FIPS	TLS_RSA_WITH_AES_256_CBC_SHA TLS_RSA_WITH_AES_128_CBC_SHA TLS_RSA_WITH_3DES_EDE_CBC_SHA TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA TLS_DHE_RSA_WITH_3DES_EDE_CBC_SHA TLS_RSA_WITH_DES_CBC_SHA TLS_DHE_DSS_WITH_DES_CBC_SHA TLS_DHE_RSA_WITH_DES_CBC_SHA TLS_RSA_EXPORT1024_WITH_DES_CBC_SHA TLS_DHE_DSS_EXPORT1024_WITH_DES_CBC_SHA
Strong	TLS_RSA_WITH_AES_256_CBC_SHA TLS_RSA_WITH_AES_128_CBC_SHA TLS_RSA_WITH_3DES_EDE_CBC_SHA TLS_RSA_WITH_RC4_128_SHA TLS_RSA_WITH_RC4_128_MD5 TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA TLS_DHE_DSS_WITH_RC4_128_SHA TLS_DHE_RSA_WITH_3DES_EDE_CBC_SHA
Weak	TLS_RSA_WITH_DES_CBC_SHA TLS_DHE_DSS_WITH_DES_CBC_SHA TLS_DHE_RSA_WITH_DES_CBC_SHA TLS_RSA_EXPORT1024_WITH_DES_CBC_SHA TLS_RSA_EXPORT1024_WITH_RC4_56_SHA TLS_DHE_DSS_EXPORT1024_WITH_RC4_56_SHA TLS_DHE_DSS_EXPORT1024_WITH_DES_CBC_SHA TLS_RSA_EXPORT_WITH_RC4_40_MD5 TLS_RSA_EXPORT_WITH_DES40_CBC_SHA TLS_DHE_DSS_EXPORT_WITH_DES40_CBC_SHA TLS_DHE_RSA_EXPORT_WITH_DES40_CBC_SHA

Set name	Cipher suite names included in the set
All	TLS_RSA_WITH_AES_256_CBC_SHA
	TLS_RSA_WITH_AES_128_CBC_SHA
	TLS_RSA_WITH_3DES_EDE_CBC_SHA
	TLS_RSA_WITH_RC4_128_SHA
	TLS_RSA_WITH_RC4_128_MD5
	TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA
	TLS_DHE_DSS_WITH_RC4_128_SHA
	TLS_DHE_RSA_WITH_3DES_EDE_CBC_SHA
	TLS_RSA_WITH_DES_CBC_SHA
	TLS_DHE_DSS_WITH_DES_CBC_SHA
	TLS_DHE_RSA_WITH_DES_CBC_SHA
	TLS_RSA_EXPORT1024_WITH_DES_CBC_SHA
	TLS_RSA_EXPORT1024_WITH_RC4_56_SHA
	TLS_DHE_DSS_EXPORT1024_WITH_RC4_56_SHA
	TLS_DHE_DSS_EXPORT1024_WITH_DES_CBC_SHA
	TLS_RSA_EXPORT_WITH_RC4_40_MD5
	TLS_RSA_EXPORT_WITH_DES40_CBC_SHA
	TLS_DHE_DSS_EXPORT_WITH_DES40_CBC_SHA
	TLS_DHE_RSA_EXPORT_WITH_DES40_CBC_SHA

Table 7-2 describes Cipher suites no longer supported for Adaptive Server 15.0 and later. 15.0. Attempts to use use any dropped cipher suite results in an SSLHandshake failure and a failure to connect to Adaptive Server.

Table 7-2: Dropped Cipher suites

Set name	Cipher suite names dropped from the set
FIPS	TLS_RSA_EXPORT1024_WITH_DES_CBC_SHA
Strong	None dropped
Weak	TLS_RSA_EXPORT1024_WITH_RC4_56_SHA TLS_DHE_DSS_EXPORT_WITH_DES40_CBC_SHA TLS_DHE_RSA_EXPORT_WITH_DES40_CBC_SHA
Others	TLS_DH_anon_EXPORT_WITH_DES40_CBC_SHA TLS_DH_anon_EXPORT_WITH_RC4_40_MD5 TLS_DH_anon_WITH_3DES_EDE_CBC_SHA TLS_DH_anon_WITH_DES_CBC_SHA TLS_DH_anon_WITH_RC4_128_MD5 TLS_RSA_WITH_NULL_MD5 TLS_RSA_WITH_NULL_SHA

Examples *sp_ssladmin*

On initial startup, before any cipher suite preferences have been set, no preferences are shown by sp_ssladmin lscipher.

```
1> sp_ssladmin lscipher
2> go
```

Output:

```
 Cipher Suite Name   Preference
-----------------    ----------
(0 rows affected)
(return status = 0)
```

The following example specifies the set of cipher suites that use FIPS algorithms.

```
1> sp_ssladmin setcipher, 'FIPS'
The following cipher suites and order of preference are set for SSL connections:

Cipher Suite Name                                               Preference
--------------------------------------------------------------- -----------
TLS_RSA_WITH_AES_256_CBC_SHA                                             1
TLS_RSA_WITH_AES_128_CBC_SHA                                             2
TLS_RSA_WITH_3DES_EDE_CBC_SHA                                            3
TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA                                        4
TLS_DHE_RSA_WITH_3DES_EDE_CBC_SHA                                        5
TLS_RSA_WITH_DES_CBC_SHA                                                 6
TLS_DHE_DSS_WITH_DES_CBC_SHA                                             7
```

```
TLS_DHE_RSA_WITH_DES_CBC_SHA                                              8
TLS_RSA_EXPORT1024_WITH_DES_CBC_SHA                                       9
TLS_DHE_DSS_EXPORT1024_WITH_DES_CBC_SHA                                    10
```

A preference of 0 (zero) sp_ssladmin output indicates a cipher suite is not used by Adaptive Server. The other, non-zero numbers, indicate the preference order that Adaptive Server uses the algorithm during the SSL handshake. The client side of the SSL handshake chooses one of these cipher suites that matches its list of accepted cipher suites.

This example uses a quoted list of cipher suites to set preferences in Adaptive Server:

```
1> sp_ssladmin setcipher, 'TLS_RSA_WITH_AES_128_CBC_SHA,
TLS_RSA_WITH_AES_256_CBC_SHA'
2> go
The following cipher suites and order of preference are set for SSL connections:
Cipher Suite Name                                                 Preference
----------------------------------------------------------------- -----------
TLS_RSA_WITH_AES_128_CBC_SHA                                              1
TLS_RSA_WITH_AES_256_CBC_SHA                                               2
```

Other considerations

When you upgrade to Adaptive Server version 12.5.3 and later, the cipher suite preferences are the server defaults, and sp_ssladmin option lscipher displays no preferences. The server uses its default preferences, those defined by "All". The system security officer should consider the security policies employed at his or her site and the available SSL cipher suites to decide whether to restrict cipher suites and which cipher suites are appropriate for the security policies.

If you upgrade from Adaptive Server version 12.5.3 and later and have set cipher suite preferences, those preferences remain after upgrade. After the upgrade is complete, review your server's cipher suite preferences with current security policies and the lists of supported and unsupported cipher suites found in tables Table 7-1. Omit any cipher suites that are not supported.

If you have set SSL cipher suite preferences and want to remove all preferences from the server and use default preferences, delete the preferences from their storage location in system catalogs using the following commands:

```
1> sp_configure 'allow updates to system tables', 1
2> go

1>  delete from master..sysattributes where class=24
2>  go
```

```
1> sp_configure 'allow updates to system tables', 0
2> go
```

These commands can be executed only by the system security officer or system administrator.

Using SSL to specify a common name

The server name specified in the directory service entry can be different from the common name the SSL server certificate uses to perform an SSL handshake. This allows you to use a fully-qualified domain name for the SSL certificate common name (for example, *server1.bigcompany.com*).

To add a common name to the interfaces file, use:

```
ase1
   master tcp ether host_name port_number ssl="CN='common_name'"
   query tcp ether host_name port_number ssl="CN='common_name'"
```

When clients use SSL to connect to an Adaptive Server that also uses SSL, the SSL filter is placed after the port number in the *interfaces* file. The directory service includes the common name, which you add either by using dsedit or a text editor.

Specifying a common name with *sp_listener*

sp_listener includes the CN=*common_name* parameter, which allows you to specify a common name for the SSL certificate. The syntax is:

sp_listener 'command','[protocol:]*machine_name*:*port_number*:
"CN=*common_name*"', '*engine_number*'

Where CN=*common_name* is used only if you specify ssltcp as the protocol. The *common_name* you specify here is validated against the *common_name* in the SSL certificate. If you do not include CN=*common_name*, Adaptive Server uses *server_name* to validate against the common name in the SSL certificate. If you include a fully-qualified domain name in the certificate, it must match the CN=*common_name*.

The attribute name “CN” is case insensitive (it can be “CN”, “cn” or “Cn”), but the attribute value for the common name is case sensitive.

For example, to specify the common name `ase1.big server 1.com`:

```
sp_listener 'start','ssltcp:blade1:17251:"CN=ase1.big server 1.com"','0'
```

See the *Reference Manual: Procedures* for more information about sp_listener.

Stored procedure *sp_addserver* changed

The *filter* parameter is enhanced to specify a common name. See the *Reference Manual: Procedures*.

Kerberos confidentiality

You can also ensure the confidentiality of all messages with Adaptive Server. To require all messages into and out of Adaptive Server to be encrypted, set the msg confidentiality reqd configuration parameter to 1. If this parameter is 0 (the default), message confidentiality is not required but may be established by the client.

For example, to require that all messages be encrypted, execute:

```
sp_configure "msg confidentiality reqd", 1
```

For more information about using Message Confidentiality with Kerberos and other Security Services supported, see “Administering network-based security” on page 94.

Dumping and loading databases with password protection

You can protect your database dump from unauthorized loads using the password parameter of the dump database command. If you include the password parameter when you make a database dump, you must also include this password when you load the database.

The partial syntax for the password-protected dump database and load database commands are:

dump database *database_name* to *file_name* [with passwd = *password*] load database *database_name* from *file_name* [with passwd = *password*]

where:

- *database_name* – is the name of the database that is being dump or loaded.
- *file_name* – is the name of the dump file.
- *password* – is the password you provide to protect the dump file from unauthorized users.

Your password must be between 6 and 30 characters long. If you provide a password that is less than 6 or greater than 30 characters, Adaptive server issues an error message. If you issue an incorrect password when you attempt to load the database, Adaptive Server issues an error message and the command fails.

For example, the following uses the password "bluesky" to protect the database dump of the pubs2 database:

```
dump database pubs2 to "/Syb_backup/mydb.db" with passwd = "bluesky"
```

The database dump must be loaded using the same password:

```
load database pubs2 from "/Syb_backup/mydb.db" with passwd = "bluesky"
```

Passwords and earlier versions of Adaptive Server

You can use the password-protected dump and load commands only with Adaptive Server version 12.5.2 and later. If you use the password parameter on a dump of a 12.5.2 version of Adaptive Server, the load fails if you try to load it on an earlier version of Adaptive Server.

Passwords and character sets

You can load the dump only to another server with the same character set. For example, if you attempt to load a dump from a server that uses an ASCII character set to a server that uses a non-ASCII character set, the load fails because the value of the ASCII password is different from the non-ASCII password.

Passwords entered by users are converted to Adaptive Server's local character set. Because ASCII characters generally have the same value representation across character sets, if a user's password is in an ASCII character set, the passwords for dump and load are recognized across all character sets.

Adaptive Server version 15.0.2 and later allows you to store portable passwords. See "Character set considerations for passwords" on page 41.

CHAPTER 8 Auditing

This chapter describes how to set up auditing for your installation.

Introduction to auditing in Adaptive Server

A principal element of a secure system is accountability. One way to ensure accountability is to audit events on the system. Many events that occur in Adaptive Server can be recorded.

Auditing is an important part of security in a database management system. An audit trail can be used to detect penetration of the system and misuse of resources. By examining the audit trail, a system security officer can inspect patterns of access to objects in databases and can monitor the activity of specific users. Audit records are traceable to specific users, which may act as a deterrent to users who are misusing the system.

Each audit record can log the nature of the event, the date and time, the user responsible for it, and the success or failure of the event. Among the events that can be audited are log ins and log outs, server starts, use of data access commands, attempts to access particular objects, and a particular user's actions. The **audit trail**, or log of audit records, allows the system security officer to reconstruct events that occurred on the system and evaluate their impact.

The system security officer is the only user who can start and stop auditing, set up auditing options, and process the audit data. As a system security officer, you can establish auditing for events such as:

- Server-wide, security-relevant events

- Creating, deleting, and modifying database objects
- All actions by a particular user or all actions by users with a particular role active
- Granting or revoking database access
- Importing or exporting data
- Log ins and log outs

Correlating Adaptive Server and operating system audit records

The easiest way to link Adaptive Server audit records with operating system records is to make Adaptive Server login names the same as operating system login names.

Alternatively, the system security officer can map users' operating system login names to their Adaptive Server login names. However, this approach requires ongoing maintenance, as login names for new users must be recorded manually.

The audit system

The audit system consists of:

- The sybsecurity database, which contains global auditing options and the audit trail
- The in-memory audit queue, to which audit records are sent before they are written to the audit trail
- Configuration parameters for managing auditing
- System procedures for managing auditing

The *sybsecurity* database

The sybsecurity database is created during the auditing installation process. In addition to all the system tables found in the model database, it contains sysauditoptions, a system table for keeping track of server-wide auditing options, and system tables for the audit trail.

sysauditoptions contains the current setting of global auditing options, such as whether auditing is enabled for disk commands, remote procedure calls, ad hoc user-defined auditing records, or all security-relevant events. These options affect the entire Adaptive Server.

The audit trail

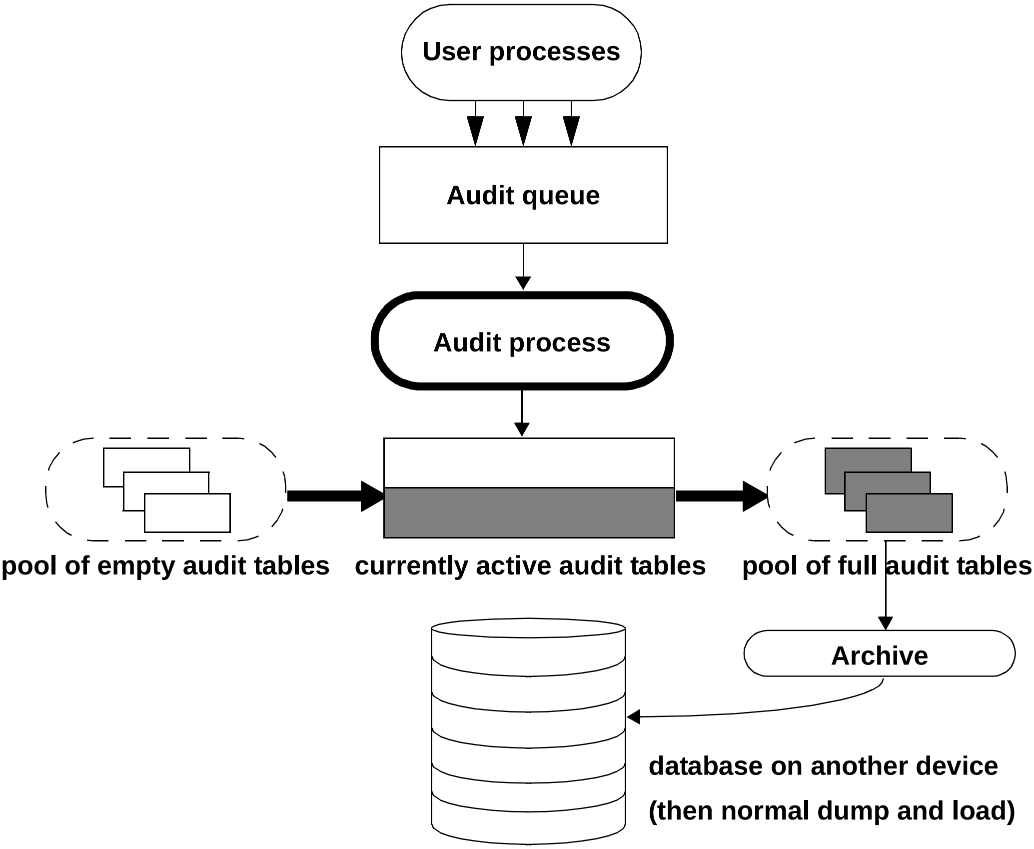
Adaptive Server stores the audit trail in system tables named sysaudits_01 through sysaudits_08. When you install auditing, you determine the number of audit tables for your installation. For example, if you choose to have two audit tables, they are named sysaudits_01 and sysaudits_02. At any given time, only one audit table is current. Adaptive Server writes all audit data to the current audit table. A system security officer can use sp_configure to set (or change) which audit table is current.

Sybase recommends two or more audit tables, with each table on a separate audit device. This allows you to set up a smoothly running auditing process in which audit tables are archived and processed with no loss of audit records and no manual intervention.

Warning! Sybase strongly recommends against using a single audit table on production systems. If you use only a single audit table, you may lose audit records. If you must use only a single audit table because of limited system resources, see "Single-table auditing" on page 284 for instructions.

Figure 8-1 shows how the auditing process works with multiple audit tables.

Figure 8-1: Auditing with multiple audit tables



The auditing system writes audit records from the in-memory audit queue to the current audit table. When the current audit table is nearly full, a threshold procedure can automatically archive the table to another database. The archive database can be backed up and restored with the dump and load commands. Use archive database access for read-only access to archived audit tables from backup. See Chapter 14, "Archive Database Access," in the *System Administration Guide, Volume 2*. For more information about managing the audit trail, see "Setting up audit trail management" on page 276.

The audit queue

When an audited event occurs, an audit record first goes to the in-memory audit queue. The record remains in memory until the audit process writes it to the audit trail. You can configure the size of the audit queue with the audit queue size parameter of sp_configure.

Before you configure the size of the audit queue, consider the trade-off between the risk of losing records in the queue if the system crashes and the loss of performance when the queue is full. As long as an audit record is in the queue, it can be lost if the system crashes. However, if the queue repeatedly becomes full, overall system performance is affected. If the audit queue is full when a user process tries to generate an audit record, the process sleeps until space in the queue becomes available.

Note Because audit records are not written directly to the audit trail, you cannot count on an audit record's being stored immediately in the current audit table.

Auditing configuration parameters

Use these configuration parameters to manage the auditing process:

- auditing enables or disables auditing for the entire Adaptive Server. The parameter takes effect immediately upon execution of sp_configure. Auditing occurs only when this parameter is enabled.
- audit queue size establishes the size of the audit queue. Because the parameter affects memory allocation, the parameter does not take effect until Adaptive Server is restarted.
- suspend audit when device full controls the behavior of the audit process when an audit device becomes full. The parameter takes effect immediately upon execution of sp_configure.
- current audit table sets the current audit table. The parameter takes effect immediately upon execution of sp_configure.

System procedures for auditing

Use these system procedures to manage the auditing process:

- sp_audit enables and disables auditing options. This is the only system procedure required to establish the events to be audited.

- sp_displayaudit displays the active auditing options.
- sp_addauditrecord adds user-defined audit records (comments) into the audit trail. Users can add these records only if a system security officer enables ad hoc auditing with sp_audit.

Installing and setting up auditing

Table 8-1: General procedure of auditing

Action and description	See
1. Install auditing – set the number of audit tables and assign devices for the audit trail and the syslogs transaction log in the sybsecurity database.	"Installing the audit system" on page 272 and the Adaptive Server installation and configuration documentation
2. Set up audit trail management – write and establish a threshold procedure that receives control when the current audit table is nearly full. The procedure automatically switches to a new audit table and archives the contents of the current table. In addition, this step involves setting the audit queue size and the suspend audit when device full configuration parameters.	"Setting up audit trail management" on page 276 For single-table auditing, "Single-table auditing" on page 284
3. Set up transaction log management in the sybsecurity database – determine how to handle the syslogs transaction log in the sybsecurity database, how to set the trunc log on chkpt database option and establishing a last-chance threshold procedure for syslogs if trunc log on chkpt is off.	"Setting up transaction log management" on page 282
4. Set auditing options – use sp_audit to establish the events to be audited.	"Setting global auditing options" on page 288
5. Enable auditing – use sp_configure to turn on the auditing configuration parameter. Adaptive Server begins writing audit records to the current audit table.	"Enabling and disabling auditing" on page 284
6. Restarting auditing – use sp_audit restart to restart auditing if it fails.	"Restarting auditing" on page 287

Installing the audit system

The audit system is usually installed with auditinit, the Sybase installation program. Alternatively, you can install auditing without auditinit. For details, see "Installing auditing with installsecurity" on page 273. Installation and auditinit are discussed in the Adaptive Server installation and configuration documentation for your platform.

When you install auditing, you can establish the number of system tables you want to use for the audit trail, the device for each audit system table, and the device for the syslogs transaction log.

Tables and devices for the audit trail

You can specify up to eight system tables (sysaudits_01 through sysaudits_08). Plan to use at least two tables for the audit trail. Put each table on its own device separate from the master device. If you do this, you can use a threshold procedure to automatically archive the current audit table before it fills up and switches to a new empty table for the subsequent audit records.

Device for the *syslogs* transaction log table

When you install auditing, you must specify a separate device for the transaction log, which consists of the syslogs system table. The syslogs table, which exists in every database, contains a log of the transactions that are executed in the database.

Installing auditing with *installsecurity*

The *$SYBASE/ASE-15_0/scripts* directory contains *installsecurity*, a script for installing auditing.

Note This example assumes a server that uses a logical page size of 2K.

To use *installsecurity* to install auditing:

1 Create the auditing devices and auditing database with the disk init and create database commands. For example:

```
disk init name = "auditdev",
    physname = "/dev/dsk/c2d0s4",
    size = "10M"
disk init name = "auditlogdev",
    physname = "/dev/dsk/c2d0s5",
    size = "2M"
create database sybsecurity on auditdev
    log on auditlogdev
```

2 Use isql to execute the *installsecurity* script:

```
cd $SYBASE/ASE-12_5/scripts
setenv DSQUERY server_name
```

```
isql -Usa -Ppassword -Sserver_name < installsecurity
```

3 Shut down and restart Adaptive Server.

When you have completed these steps, the sybsecurity database has one audit table (sysaudits_01) created on its own segment. You can enable auditing at this time, but should add more auditing tables with sp_addaudittable. For information about disk init, create database, and sp_addaudittable, see the *Reference Manual: Procedures*.

Moving the auditing database to multiple devices

Place the sybsecurity database on its own device, separate from the master database. If you have more than one audit table, place each table on its own device. It can also be helpful to put each table on a separate segment which points to a separate device. If you currently have sybsecurity on the same device as master, or if you want to move sybsecurity to another device, use one of the procedures described in the following sections. When you move the database, you can specify whether to save your existing global audit settings.

Moving *sybsecurity* without saving global audit settings

Note These steps include dropping the sybsecurity database, which destroys all audit records and global audit settings previously recorded in sybsecurity. Before you drop the sybsecurity database, make sure you archive existing records with a backup or by following instructions in "Archiving the audit table" on page 277 to avoid losing any historical data that remains in the sybsecurity tables.

To move the sybsecurity database without saving the global audit settings:

1 Execute the following to remove any information related to logins from the syslogins system table:

```
sp_audit "all","all","all","off"
```

2 Drop the sybsecurity database.

3 Install sybsecurity again using the installation procedure described in either:

- The configuration documentation for your platform, or
- "Installing auditing with installsecurity" on page 273.

4 During the installation process, place the sybsecurity database on one or more devices, separate from the master device.

Moving *sybsecurity* and saving global audit settings

v **To move the *sybsecurity* database and save the global audit settings**

1 Dump the sybsecurity database:

```
dump database sybsecurity to "/remote/sec_file"
```

2 Drop the sybsecurity database:

```
drop database sybsecurity
```

3 Initialize the first device on which you want to place the sybsecurity database:

```
disk init name = "auditdev",
    physname = "/dev/dsk/c2d0s4",
    size = "10M"
```

4 Initialize the device where you want to place the security log:

```
disk init name = "auditlogdev",
    physname = "/dev/dsk/c2d0s5",
    size = "2M"
```

5 Create the new sybsecurity database:

```
create database sybsecurity on auditdev
    log on auditlogdev
```

6 Load the contents of the old sybsecurity database into the new database. The global audit settings are preserved:

```
load database sybsecurity from "/remote/sec_file"
```

7 Run online database, which upgrades sysaudits and sysauditoptions if necessary:

```
online database sybsecurity
```

8 Load the auditing system procedures using the configuration documentation for your platform.

v **Creating more than one *sysaudits* table in *sybsecurity***

1 Initialize the device where you want to place the additional table:

```
disk init name = "auditdev2",
    physname = "/dev/dsk/c2d0s6",
    size = "10M"
```

2 Extend the sybsecurity database to the device you initialized in step 1:

```
alter database sybsecurity on auditdev2 = "2M"
```

3 Run sp_addaudittable to create the next sysaudits table on the device you initialized in step 1:

```
sp_addaudittable auditdev2
```

4 Repeat steps 1 – 3 for each sysaudits table.

Setting up audit trail management

To effectively manage the audit trail:

1 Be sure that auditing is installed with two or more tables, each on a separate device. If not, consider adding additional audit tables and devices.

2 Write a threshold procedure and attach it to each audit table segment.

3 Set configuration parameters for the audit queue size and to indicate appropriate action should the current audit table become full.

The following sections assume that you have installed auditing with two or more tables, each on a separate device. If you have only one device for the audit tables, skip to “Single-table auditing” on page 284.

Setting up threshold procedures

Before enabling auditing, establish a threshold procedure to automatically switch auditing tables when the current table is full.

The threshold procedure for the audit device segments should:

- Make the next empty audit table current using sp_configure to set the current audit table configuration parameter.
- Archive the audit table that is almost full using the insert...select command.

Changing the current audit table

The current audit table configuration parameter establishes the table where Adaptive Server writes audit rows. As a system security officer, you can change the current audit table with sp_configure, using the following syntax, where *n* is an integer that determines the new current audit table:

```
sp_configure "current audit table", n
```

```
[, "with truncate"]
```

The valid values for *n* are:

- 1 means sysaudits_01, 2 means sysaudits_02, and so forth.
- 0 tells Adaptive Server to automatically set the current audit table to the next table. For example, if your installation has three audit tables, sysaudits_01, sysaudits_02, and sysaudits_03, Adaptive Server sets the current audit table to:
  - 2 if the current audit table is sysaudits_01
  - 3 if the current audit table is sysaudits_02
  - 1 if the current audit table is sysaudits_03

The with truncate option specifies that Adaptive Server should truncate the new table if it is not already empty. If you do not specify this option and the table is not empty, sp_configure fails.

Note If Adaptive Server truncates the current audit table and you have not archived the data, the table's audit records are lost. Archive the audit data before you use the with truncate option.

To execute sp_configure to change the current audit table, you must have the sso_role active. You can write a threshold procedure to automatically change the current audit table.

Archiving the audit table

You can use insert with select to copy the audit data into an existing table having the same columns as the audit tables in sybsecurity.

Be sure that the threshold procedure can successfully copy data into the archive table in another database:

1. Create the archive database on a separate device from the one containing audit tables in sybsecurity.
2. Create an archive table with columns identical to those in the sybsecurity audit tables. If such a table does not already exist, you can use select into to create an empty one by having a false condition in the where clause. For example:

   ```
   use aud_db
   go
   select *
   ```

```
into audit_data
from sybsecurity.dbo.sysaudits_01
where 1 = 2
```

The where condition is always false, so an empty duplicate of sysaudits_01 is created.

The select into/bulk copy database option must be turned on in the archive database (using sp_dboption) before you can use select into.

The threshold procedure, after using sp_configure to change the audit table, can use insert and select to copy data to the archive table in the archive database. The procedure can execute commands similar to these:

```
insert aud_db.sso_user.audit_data
select * from sybsecurity.dbo.sysaudits_01
```

Example threshold procedure for audit segments

This sample threshold procedure assumes that three tables are configured for auditing:

```
declare @audit_table_number int
/*
** Select the value of the current audit table
*/
select @audit_table_number = scc.value
from master.dbo.syscurconfigs scc, master.dbo.sysconfigures sc
where sc.config=scc.config and sc.name  = "current audit table"
/*
** Set the next audit table to be current.
** When the next audit table is specified as 0,
** the value is automatically set to the next one.
*/
exec sp_configure "current audit table", 0, "with truncate"
/*
** Copy the audit records from the audit table
** that became full into another table.
*/
if @audit_table_number = 1
    begin
        insert aud_db.sso_user.sysaudits
            select * from sysaudits_01
        truncate table sysaudits_01
    end
else if @audit_table_number = 2
    begin
        insert aud_db.sso_user.sysaudits
```

```
            select * from sysaudits_02
        truncate table sysaudits_02
    end
return(0)
```

Attaching the threshold procedure to each audit segment

To attach the threshold procedure to each audit table segment, use the sp_addthreshold.

Before executing sp_addthreshold:

- Determine the number of audit tables configured for your installation and the names of their device segments
- Have the permissions and roles you need for sp_addthreshold for all the commands in the threshold procedure

---

Warning! sp_addthreshold and sp_modifythreshold check to ensure that only a user with sa_role directly granted can add or modify a threshold. All system-defined roles that are active when you add or modify a threshold are inserted as valid roles for your login in the systhresholds table. However, only directly granted roles are activated when the threshold procedure fires.

Audit tables and their segments

When you install auditing, auditinit displays the name of each audit table and its segment. The segment names are “aud_seg1” for sysaudits_01, “aud_seg2” for sysaudits_02, and so forth. You can find information about the segments in the sybsecurity database if you execute sp_helpsegment with sybsecurity as your current database. One way to find the number of audit tables for your installation is to execute the following SQL commands:

```
use sybsecurity
go
select count(*) from sysobjects
    where name like "sysaudit%"
go
```

Get additional information about the audit tables and the sybsecurity database by executing the following SQL commands:

```
sp_helpdb sybsecurity
go
use sybsecurity
```

```
go
sp_help sysaudits_01
go
sp_help sysaudits_02
go
  ...
```

Required roles and permissions

To execute sp_addthreshold, you must be either the database owner or a system administrator. A system security officer should be the owner of the sybsecurity database and, therefore, should be able to execute sp_addthreshold. In addition to being able to execute sp_addthreshold, you must have permission to execute all the commands in your threshold procedure. For example, to execute sp_configure for current audit table, the sso_role must be active. When the threshold procedure fires, Adaptive Server attempts to turn on all the roles and permissions that were in effect when you executed sp_addthreshold.

To attach the threshold procedure audit_thresh to three device segments:

```
use sybsecurity
go
sp_addthreshold sybsecurity, aud_seg_01, 250, audit_thresh
sp_addthreshold sybsecurity, aud_seg_02, 250, audit_thresh
sp_addthreshold sybsecurity, aud_seg_03, 250, audit_thresh
go
```

The sample threshold procedure audit_thresh receives control when fewer than 250 free pages remain in the current audit table.

For more information about adding threshold procedures, see Chapter 16, “Managing Free Space with Thresholds,” in *System Administration Guide: Volume 2.*

Auditing with the sample threshold procedure in place

After you enable auditing, Adaptive Server writes all audit data to the initial current audit table, sysaudits_01. When sysaudits_01 is within 250 pages of being full, the threshold procedure audit_thresh fires. The procedure switches the current audit table to sysaudits_02, and, immediately, Adaptive Server starts writing new audit records to sysaudits_02. The procedure also copies all audit data from sysaudits_01 to the audit_data archive table in the audit_db database. The rotation of the audit tables continues in this fashion without manual intervention.

Setting auditing configuration parameters

Set the following configuration parameters for your auditing installation:

- audit queue size sets the number of records in the audit queue in memory.
- suspend audit when device full determines what Adaptive Server does if the current audit table becomes completely full. The full condition occurs only if the threshold procedure attached to the current table segment is not functioning properly.

Setting the size of the audit queue

The default audit queue size is 100 bytes. The amount of memory consumed by the audit queue pool is defined the audit queue size parameter, and includes data buffers and overhead for the memory pool. However, the amount of memory in the pool can vary between releases and chip architectures.

Use sp_configure to set the length of the audit queue. The syntax is:

sp_configure "audit queue size", [*value*]

value is the number of records that the audit queue can hold. The minimum value is 1, and the maximum is 65,535. For example, to set the audit queue size to 300, execute:

```
sp_configure "audit queue size", 300
```

For more information about setting the audit queue size and other configuration parameters, see Chapter 5, "Setting Configuration Parameters" in the *System Administration Guide: Volume 1*.

Suspending auditing if devices are full

If you have two or more audit tables, each on a separate device other than the master device, and have a threshold procedure for each audit table segment, the audit devices should never become full. Only if a threshold procedure is not functioning properly would the "full" condition occur. Use sp_configure to set the suspend audit when device full parameter to determine what happens if the devices do become full. Choose one of these options:

- Suspend the auditing process and all user processes that cause an auditable event. Resume normal operation after a system security officer clears the current audit table.
- Truncate the next audit table and start using it. This allows normal operation to proceed without intervention from a system security officer.

Use sp_configure to set this configuration parameter. You must have the sso_role active. The syntax is:

```
sp_configure "suspend audit when device full",
    [0|1]
```

- 0 – truncates the next audit table and starts using it as the current audit table whenever the current audit table becomes full. If you set the parameter to 0, the audit process is never suspended; however, older audit records are lost if they have not been archived.
- 1 (the default value) – suspends the audit process and all user processes that cause an auditable event. To resume normal operation, the system security officer must log in and set up an empty table as the current audit table. During this period, the system security officer is exempt from normal auditing. If the system security officer's actions would generate audit records under normal operation, Adaptive Server sends an error message and information about the event to the error log.

If you have a threshold procedure attached to the audit table segments, set suspend audit when device full to 1 (on). If it is set to 0 (off), Adaptive Server may truncate the audit table that is full before your threshold procedure has a chance to archive your audit records.

Setting up transaction log management

This section describes guidelines for managing the transaction log in sybsecurity.

If the trunc log on chkpt database option is active, Adaptive Server truncates syslogs every time it performs an automatic checkpoint. After auditing is installed, the value of trunc log on chkpt is on, but you can use sp_dboption to change its value.

Truncating the transaction log

If you enable the trunc log on chkpt option for the sybsecurity database, you do not need to worry about the transaction log becoming full. Adaptive Server truncates the log whenever it performs a checkpoint. With this option enabled, you cannot use dump transaction to dump the transaction log, but you can use dump database to dump the database.

If you follow the procedures in “Setting up threshold procedures” on page 276, audit tables are automatically archived to tables in another database. You can use standard backup and recovery procedures for this archive database.

If a crash occurs on the sybsecurity device, you can reload the database and resume auditing. At most, only the records in the in-memory audit queue and the current audit table are lost because the archive database contains all other audit data. After you reload the database, use sp_configure with truncate to set and truncate the current audit table.

If you have not changed server-wide auditing options since you dumped the database, all auditing options stored in sysauditoptions are automatically restored when you reload sybsecurity. If not, you can run a script to set the options prior to resuming auditing.

Managing the transaction log with no truncation

If you use db_option to turn the trunc log on chkpt off, the transaction log may fill up. Plan to attach a *last-chance threshold procedure* to the transaction log segment. This procedure gets control when the amount of space remaining on the segment is less than a threshold amount computed automatically by Adaptive Server. The threshold amount is an estimate of the number of free log pages that are required to back up the transaction log.

The default name of the last-chance threshold procedure is sp_thresholdaction, but you can specify a different name with sp_modifythreshold, as long as you have the sa_role active.

Note sp_modifythreshold checks to ensure you have “sa_role” active. See “Attaching the threshold procedure to each audit segment” on page 279 for more information.

Adaptive Server does not supply a default procedure, but Chapter 16, “Managing Free Space with Thresholds,” in *System Administration Guide: Volume 2* contains examples of last-chance threshold procedures. The procedure should execute the dump transaction command, which truncates the log. When the transaction log reaches the last-chance threshold point, any transaction that is running is suspended until space is available. The suspension occurs because the option abort xact when log is full is always set to false for the sybsecurity database. You cannot change this option.

With the trunc log on chkpt option disable, you can use standard backup and recovery procedures for the sybsecurity database, but be aware that the audit tables in the restored database may not be in sync with their status during a device failure.

Enabling and disabling auditing

Use sp_configure with the auditing configuration parameter to enable or disable auditing. The syntax is:

sp_configure "auditing", [0 | 1]

- 1 – enables auditing.
- 0 – disables auditing.

For example, to enable auditing, enter:

```
sp_configure "auditing", 1
```

Note When you enable or disable auditing, Adaptive Server automatically generates an audit record. See event codes 73 and 74 in Table 8-5 on page 301.

Single-table auditing

Sybase strongly recommends that you not use single-device auditing for production systems. If you use only a single audit table, you create a window of time while you are archiving audit data and truncating the audit table during which incoming audit records are lost. There is no way to avoid this when using only a single audit table.

If you use only a single audit table, your audit table is likely to fill up. The consequences of this depend on how you have set suspend audit when device full. If you have suspend audit when device full set to on, the audit process is suspended, as are all user processes that cause auditable events. If suspend audit when device full is off, the audit table is truncated, and you lose all the audit records that were in the audit table.

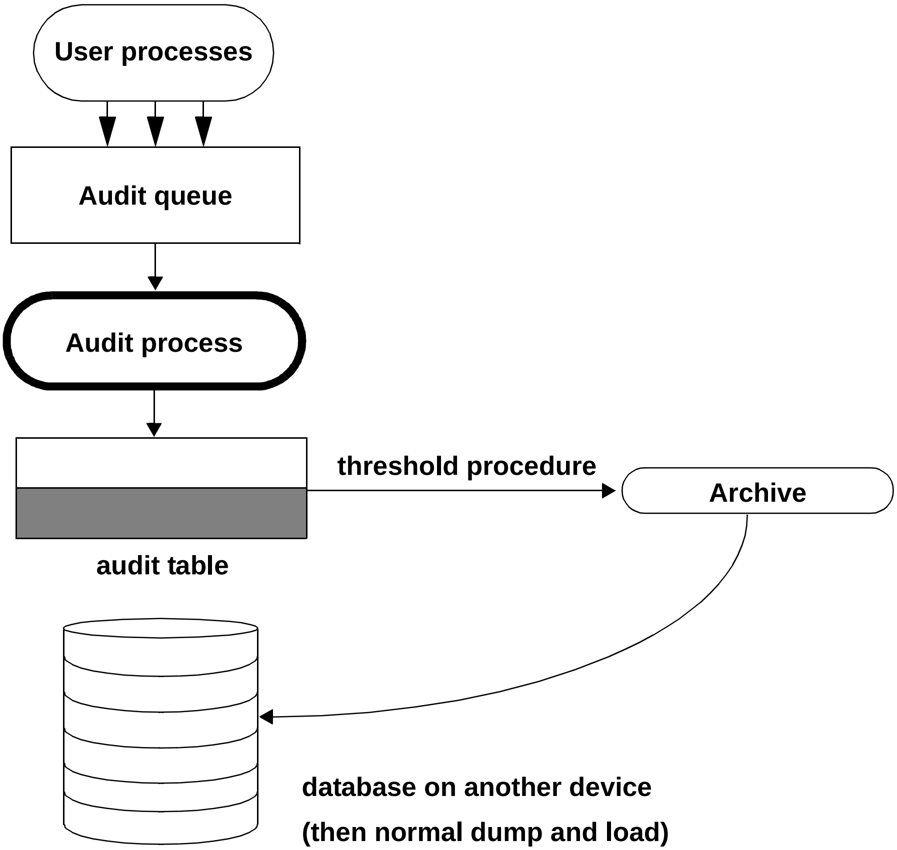
For non-production systems, where the loss of a small number of audit records may be acceptable, you can use a single table for auditing, if you cannot spare the additional disk space for multiple audit tables, or you do not have additional devices to use.

The procedure for using a single audit table is similar to using multiple audit tables, with these exceptions:

- During installation, you specify only one system table to use for auditing.
- During installation, you specify only one device for the audit system table.
- The threshold procedure you create for archiving audit records is different from the one you would create if you were using multiple audit tables.

Figure 8-2 shows how the auditing process works with a single audit table.

Figure 8-2: Auditing with a single audit table



Establishing and managing single-table auditing

The steps to configure for single-table auditing is the same as for multiple-table auditing.

Threshold procedure for single-table auditing

For single-table auditing, the threshold procedure should:

- Archive the almost-full audit table to another table, using the insert and select commands.
- Truncate the audit table to create space for new audit records, using the truncate table command.

Before you can archive your audit records, create an archive table that has the same columns as your audit table. After you have done this, your threshold procedure can use insert with select to copy the audit records into the archive table.

Here is a sample threshold procedure for use with a single audit table:

```
create procedure audit_thresh as
/*
** copy the audit records from the audit table to
** the archive table
*/
insert aud_db.sso_user.audit_data
    select * from sysaudits_01
return(0)
go
/*
** truncate the audit table to make room for new
** audit records
*/
truncate table “sysaudits_01”
go
```

After you have created your threshold procedure, you will need to attach the procedure to the audit table segment. For instructions, see “Attaching the threshold procedure to each audit segment” on page 279.

Warning! On a multiprocessor, the audit table may fill up even if you have a threshold procedure that triggers before the audit table is full. For example, if the threshold procedure is running on a heavily loaded CPU, and a user process performing auditable events is running on a less heavily loaded CPU, the audit table may fill up before the threshold procedure triggers. The configuration parameter suspend audit when device full determines what happens when the audit table fills up. For information about setting this parameter, see “Suspending auditing if devices are full” on page 281.

What happens when the current audit table is full?

When the current audit table is full:

1. The audit process attempts to insert the next audit record into the table. This fails, so the audit process terminates. An error message is written to the error log.
2. When a user attempts to perform an auditable event, the event cannot be completed because auditing cannot proceed. The user process terminates. Users who do not attempt to perform an auditable event are unaffected.
3. If you have login auditing enabled, no one can log in to the server except a system security officer.
4. If you are auditing commands executed with the sso_role active, the system security officer cannot execute commands.

Recovering when the current audit table is full

If the current audit device and the audit queue become full, the system security officer becomes exempt from auditing. Every auditable event performed by a system security officer after this point sends a warning message to the error log file. The message states the date and time and a warning that an audit has been missed, as well as the login name, event code, and other information that would normally be stored in the extrainfo column of the audit table.

When the current audit table is full, the system security officer can archive and truncate the audit table as described in "Archiving the audit table" on page 277. A system administrator can execute shutdown to stop the server and then restart the server to reestablish auditing.

If the audit system terminates abnormally, the system security officer can shut down the server after the current audit table has been archived and truncated. Normally, only the system administrator can execute shutdown.

Restarting auditing

If the audit process is forced to terminate due to an error, sp_audit can be manually restarted by entering:

```
sp_audit restart
```

The audit process can be restarted provided that no audit was currently running, but the audit process must be enabled with sp_configure "auditing" 1.

Setting global auditing options

After you have installed auditing, you can use sp_audit to set auditing options. The syntax for sp_audit is:

sp_audit *option*, *login_name*, *object_name* [,*setting*]

If you run sp_audit with no parameters, it provides a complete list of the options. For details about sp_audit, see *Reference Manual: Procedures*.

Note Auditing does not occur until you activate auditing for the server. For information on how to start auditing, see "Enabling and disabling auditing" on page 284.

Auditing options: types and requirements

The values you can specify for the *login_name* and *object_name* parameters to sp_audit depend on the type of auditing option you specify:

- Global options apply to commands that affect the entire server, such as booting the server, disk commands, and allowing ad hoc, user-defined audit records. Option settings for global events are stored in the sybsecurity..sysauditoptions system table.
- Database-specific options apply to a database. Examples include altering a database, bulk copy (bcp in) of data into a database, granting or revoking access to objects in a database, and creating objects in a database. Option settings for database-specific events are stored in the master..sysdatabases system table.
- Object-specific options apply to a specific object. Examples include selecting, inserting, updating, or deleting rows of a particular table or view and the execution of a particular trigger or procedure. Option settings for object-specific events are stored in the sysobjects system table in the relevant database.
- User-specific options apply to a specific user or system role. Examples include accesses by a particular user to any table or view or all actions performed when a particular system role, such as sa_role, is active. Option settings for individual users are stored in master..syslogins. The settings for system roles are stored in master..sysauditoptions.

- Role-specific options apply to a specific user, groups, or system roles, and provide fine-grained security-related auditing. The "role" audit option audits all role-related commands, and audit options create, alter, and drop are used to audit role-definition commands, while grant and revoke are used to audit the granting of roles to subjects. The master database is specified for audit options that require an object name parameter.

Table 8-2 shows:

- Valid values for the option and the type of each option – global, database-specific, object-specific, or user-specific
- Valid values for the *login_name* and *object_name* parameters for each option
- The database to be in when you set the auditing option
- The command or access that is audited when you set the option
- An example for each option

The default value for all options is off.

Table 8-2: Auditing options, requirements, and examples

Option (option type)	*login_name*	*object_name*	Database to be in to set the option	Command or access being audited
adhoc (user-specific)	all	all	Any	Allows users to use sp_addauditrecord
	This example enables ad hoc user-defined auditing records: `sp_audit "adhoc", "all", "all", "on"`			
all (user-specific)	A login name or role	all	Any	All actions of a particular user or by users with a particular role active
	This example turns auditing on for all actions in which the sa_role is active: `sp_audit "all", "sa_role", "all", "on"`			
alter (database-specific)	all	Database to be audited	Any	alter database, alter role, alter table
	This example turns auditing on for all executions of alter database and alter table in the master database: `sp_audit @option = "alter", @login_name = "all", @object_name = "master", @setting = "on"`			

<table>
<tr><th>Option (option type)</th><th>login_name</th><th>object_name</th><th>Database to be in to set the option</th><th>Command or access being audited</th></tr>
<tr><td rowspan="2">bcp
(database-specific)</td><td>all</td><td>Database to be audited</td><td>Any</td><td>bcp in</td></tr>
<tr><td colspan="4">This example returns the status of bcp auditing in the pubs2 database:
<code>sp_audit "bcp", "all", "pubs2"</code>
If you do not specify a value for setting, Adaptive Server returns the status of auditing for the option you specify)</td></tr>
<tr><td rowspan="2">bind
(database-specific)</td><td>all</td><td>Database to be audited</td><td>Any</td><td>sp_bindefault, sp_bindmsg, sp_bindrule</td></tr>
<tr><td colspan="4">This example turns bind auditing off for the planning database:
<code>sp_audit "bind", "all", "planning", "off"</code></td></tr>
<tr><td rowspan="2">cmdtext
(user-specific)</td><td>Login name of the user to be audited</td><td>all</td><td>Any</td><td>SQL text entered by a user.
(Does not reflect whether or not the text in question passed permission checks or not. eventmod always has a value of 1.)</td></tr>
<tr><td colspan="4">This example turns text auditing off for database owners:
<code>sp_audit "cmdtext", "sa", "all", "off"</code></td></tr>
<tr><td rowspan="2">create
(database-specific)</td><td>all</td><td>Database to be audited</td><td>Any</td><td>create database, create table, create role, create procedure, create trigger, create rule, create default, sp_addmessage, create view, create index, create function</td></tr>
<tr><td colspan="4">Note Specify master for object_name to audit create database. You are also auditing the creation of other objects in master.
This example turns on auditing of successful object creations in the planning database:
<code>sp_audit "create", "all", "planning", "pass"</code>
The current status of auditing create database is not affected because you did not specify the master database.)</td></tr>
<tr><td rowspan="2">dbaccess
(database-specific)</td><td>all</td><td>Database to be audited</td><td>Any</td><td>Any access to the database from another database</td></tr>
<tr><td colspan="4">This example audits all external accesses to the project database:
<code>sp_audit "dbaccess", "all", "project", "on"</code></td></tr>
<tr><td rowspan="2">dbcc
(global)</td><td>all</td><td>all</td><td>Any</td><td>All dbcc commands that require permissions</td></tr>
<tr><td colspan="4">This example audits all executions of the dbcc command:
<code>sp_audit "dbcc", "all", "all", "on"</code></td></tr>
</table>

Option (option type)	*login_name*	*object_name*	Database to be in to set the option	Command or access being audited
delete (object-specific)	all	Name of the table or view to be audited, or default view or default table	The database of the table or view (except tempdb)	delete from a table, delete from a view
	This example audits all delete actions for all future tables in the current database: `sp_audit "delete", "all", "default table", "on"`			
disk (global)	all	all	Any	disk init, disk refit, disk reinit, disk mirror, disk unmirror, disk remirror, disk resize
	This example audits all disk actions for the server: `sp_audit "disk", "all", "all", "on"`			
drop (database-specific)	all	Database to be audited	Any	drop database, drop table, drop role, drop procedure, drop index, drop trigger, drop rule, drop default, sp_dropmessage, drop view, drop function
	This example audits all drop commands in the financial database that fail permission checks: `sp_audit "drop", "all", "financial", "fail"`			
dump (database-specific)	all	Database to be audited	Any	dump database, dump transaction
	This example audits dump commands in the pubs2 database: `sp_audit "dump", "all", "pubs2", "on"`			
encryption_key (database-specific)	all	Database to be audited	Any	alter encryption key create encryption key drop encryption key sp_encryption
	This example audits all the above commands in the pubs2 database: `sp_audit "encryption_key", "all", "pubs2", "on"`			
errors (global)	all	all	Any	Fatal error, non-fatal error
	This example audits errors throughout the server: `sp_audit "errors", "all", "all", "on"`			
errorlog	all	all	Any	sp_errorlog or the errorlog_admin function
	This example audits attempts to "change log" to move to a new Adaptive Server error log file: `sp_audit "errorlog", "all", "all", "on"`			

Option (option type)	*login_name*	*object_name*	Database to be in to set the option	Command or access being audited
exec_procedure (object-specific)	all	Name of the procedure to be audited or default procedure	The database of the procedure (except tempdb)	execute
	This example turns automatic auditing off for new procedures in the current database: `sp_audit "exec_procedure", "all", "default procedure", "off"`			
exec_trigger (object-specific)	all	Name of the trigger to be audited or default trigger	The database of the trigger (except tempdb)	Any command that fires the trigger
	This example audits all failed executions of the trig_fix_plan trigger in the current database: `sp_audit "exec_trigger", "all", "trig_fix_plan", "fail"`			
func_dbaccess (database-specific)	all	Name of the database you are auditing	Any	Access to the database using the following functions: curunreserved_pgs, db_name, db_id, lct_admin, setdbrepstat, setrepstatus, setrepdefmode, is_repagent_enabled, rep_agent_config, rep_agent_admin
	This example audits accesses to the strategy database via built-in functions: `sp_audit @option="func_dbaccess", @login_name="all", @object_name = "strategy", @setting = "on"`			
func_obj_access (object-specific)	all	Name of any object that has an entry in sysobjects	Any	Access to an object using the following functions: schema_inc, col_length, col_name, data_pgs, index_col, object_id, object_name, reserved_pgs, rowcnt, used_pgs, has_subquery
	This example audits accesses to the customer table via built-in functions: `sp_audit @option="func_obj_access", @login_name="all", @object_name = "customer", @setting = "on"`			
grant (database-specific)	all	Name of the database to be audited	Any	grant
	This example audits all grants in the planning database: `sp_audit @option="grant", @login_name="all", @object_name = "planning", @setting = "on"`			

Option (option type)	*login_name*	*object_name*	Database to be in to set the option	Command or access being audited
insert (object-specific)	all	Name of the view or table to which you are inserting rows, or default view or default table	The database of the object (except tempdb)	insert into a table, insert into a view
	This example audits all inserts into the dpt_101_view view in the current database: `sp_audit "insert", "all", "dpt_101_view", "on"`			
install (database-specific)	all	Database to be audited	Any	install java
	This example audits the installation of java classes in database planning: `sp_audit "install", "all", "planning", "on"`			
load (database-specific)	all	Database to be audited	Any	load database, load transaction
	This example audits all failed executions of database and transaction loads in the projects_db database: `sp_audit "load", "all", "projects_db", "fail"`			
login (global)	all	all	Any	Any login to Adaptive Server
	This example audits all failed attempts to log in to the server: `sp_audit "login", "all", "all", "fail"`			
login_locked (global)	all	all	Any	
	This example shows that the login is locked because of exceeding the configured number of failed login attempts: `sp_audit "login_locked", "all", "all", "on"`			
logout	all	all	Any	Any logout from Adaptive Server
	This example aturns auditing off of logouts from the server: `sp_audit "logout", "all", "all", "off"`			
mount (global)	all	all	Any	mount database
	This example audits all mount database commands issued: `sp_audit "mount", "all", "all", "on"`			
password	all	all	Any	Setting of global password and login policy options
	This example turns auditing on for passwords: `sp_audit "password", "all", "all", "on"`			
quiesce (global)	all	all	Any	quiesce database
	This example turns auditing on for quiesce database commands: `sp_audit "quiesce", "all", "all", "on"`			

Option (option type)	*login_name*	*object_name*	Database to be in to set the option	Command or access being audited
reference (object-specific)	all	Name of the view or table to which you are inserting rows, or default view or default table	Any	create table, alter table
	This example turns off auditing of the creation of references to the titles table: `sp_audit "reference", "all", "titles", "off"`			
remove (database-specific)	all	all	Any	Audits the removal of Java classes
	This example audits the removal of Java classes in the planning database: `sp_audit "remove", "all", "planning", "on"`			
revoke (database-specific)	all	Database to be audited	Any	revoke
	This example turns off auditing of the execution of revoke in the payments_db database: `sp_audit "revoke", "all", "payments_db", "off"`			
rpc (global)	all	all	Any	Remote procedure calls (either in or out)
	This example audits all remote procedure calls out of or into the server: `sp_audit "rpc", "all", "all", "on"`			
security (global)	all	all	Any	Server-wide security-relevant events. See the "security" option in Table 8-5.
	This example audits server-wide security-relevant events in the server: `sp_audit "security", "all", "all", "on"`			
select (object-specific)	all	Name of the view or table to which you are inserting rows, or default view or default table	The database of the object (except tempdb)	select from a table, select from a view
	This example audits all failed selects from the customer table in the current database: `sp_audit "select", "all", "customer", "fail"`			
setuser (database-specific)	all	all	Any	setuser
	This example audits all executions of setuser in the projdb database: `sp_audit "setuser", "all", "projdb", "on"`			

Option (option type)	*login_name*	*object_name*	Database to be in to set the option	Command or access being audited
table_access (user-specific)	Login name of the user to be audited.	all	Any	select, delete, update, or insert access in a table
	This example audits all table accesses by the login named “smithson”: `sp_audit "table_access", "smithson", "all", "on"`			
transfer_table (global)	all	all	Any	Server-wide option. Does not appear in sysauditoptions.
	This example audits server-wide transfer-relevant events in the server: `sp_audit "transfer_table", "tdb1.table1", "all", "on"`			
truncate (database-specific)	all	Database to be audited	Any	truncate table
	This example audits all table truncations in the customer database: `sp_audit "truncate", "all", "customer", "on"`			
unbind (database-specific)	all	Database to be audited	Any	sp_unbindefault, sp_unbindrule, sp_unbindmsg
	This example audits all failed attempts of unbinding in the master database: `sp_audit "unbind", "all", "master", "fail"`			
unmount (global)	all	all	Any	unmount database
	This example audits all attempts to unmount or create a manifest file with any database: `sp_audit "unmount", "all", "all", "on"`			
update (object-specific)	all	Name specifying the object to be audited, default table or default view	The database of the object (except tempdb)	update to a table, update to a view
	This example audits all attempts by users to update the projects table in the current database: `sp_audit "update", "all", "projects", "on"`			
view_access (user-specific)	Login name of the user to be audited	all	Any	select, delete, insert, or update to a view
	This example turns off view auditing of user “joe”: `sp_audit "view_access", "joe", "all", "off"`			

Examples of setting auditing options

Suppose you want to audit all failed deletions on the projects table in the company_operations database and for all new tables in the database. Use the object-specific delete option for the projects table and use default table for all future tables in the database. You must be in the object's database before you execute sp_audit to set object-specific auditing options:

```
sp_audit "security", "all", "all", "fail"
```

For this example, execute:

```
use company_operations
go
sp_audit "delete", "all", "projects", "fail"
go
sp_audit "delete", "all", "default table",
"fail"
go
```

Role definition auditing

Example 1 Turns on auditing for role alterations:

```
sp_audit "alter", "all", "master", "pass"
```

Example 2 Turns on auditing for successful role creations:

```
sp_audit "alter", "all", "master", "on"
```

Example 3 This example turns off auditing of dropping roles:

```
sp_audit "drop", "all", "master", "off"
```

Example 4 Turns off auditing of granting roles:

```
sp_audit "grant", "all", "master", "off"
```

Auditing is performed using the grant or role audit option generating the AUD_EVT_UDR_CMD (85) event audit record.

Example 5 Turns on auditing of revoking rules:

```
sp_audit "revoke", "all", "master", "on"
```

Auditing is performed using the revoke or role audit option generating the AUD_EVT_UDR_CMD (85) event audit record.

Hiding system stored procedure and command password parameters

When auditing is configured and enabled, and the sp_audit option 'cmdtext' is set, system stored procedure and command password parameters are replaced with a fixed length string of asterisks in the audit records contained in the audit logs.

For example, execute the following when auditing is enabled and sp_audit cmdtext is set:

```
alter login johnd with password oldpasswd modify
password 'newpasswd'
```

The command results in output similar to:

```
alter login johnd with password ****** modify password
'******'
```

This protects passwords from being seen by other with access to the audit log.

Determining current auditing settings

To determine the current auditing settings for a given option, use sp_displayaudit. The syntax is:

sp_displayaudit [*procedure* | *object* | *login* | *database* | *global* |
default_object | *default_procedure* [, *name*]]

For more information, see sp_displayaudit in *Reference Manual: Procedures*.

Adding user-specified records to the audit trail

sp_addauditrecord allows users to enter comments into the audit trail. The syntax is:

sp_addauditrecord [*text*] [, *db_name*] [, *obj_name*]
[, *owner_name*] [, *dbid*] [, *objid*]

All the parameters are optional:

- *text* – is the text of the message that you want to add to the extrainfo audit table.
- *db_name* – is the name of the database referred to in the record, which is inserted into the dbname column of the current audit table.

- *obj_name* – is the name of the object referred to in the record, which is inserted into the objname column of the current audit table.
- *owner_name* – is the owner of the object referred to in the record, which is inserted into the objowner column of the current audit table.
- *dbid* – is an integer value representing the database ID number of db_name, which is inserted into the dbid column of the current audit table. Do not place it in quotes.
- *objid* – is an integer value representing the object ID number of obj_name. Do not place it in quotes. *objid* is inserted into the objid column of the current audit table.

You can use sp_addauditrecord if:

- You have execute permission on sp_addauditrecord.
- The auditing configuration parameter was activated with sp_configure.
- The adhoc auditing option was enabled with sp_audit.

By default, only a system security officer and the database owner of sybsecurity can use sp_addauditrecord. Permission to execute it may be granted to other users.

Examples of adding user-defined audit records

The following example adds a record to the current audit table. The text portion is entered into the extrainfo column of the current audit table, "corporate" into the dbname column, "payroll" into the objname column, "dbo" into the objowner column, "10" into the dbid column, and "1004738270" into the objid column:

```
sp_addauditrecord "I gave A. Smith permission to view
the payroll table in the corporate database. This
permission was in effect from 3:10 to 3:30 pm on
9/22/92.", "corporate", "payroll", "dbo", 10,
1004738270
```

The following example inserts information only into the extrainfo and dbname columns of the current audit table:

```
sp_addauditrecord @text="I am disabling auditing
briefly while we reconfigure the system",
@db_name="corporate"
```

Querying the audit trail

To query the audit trail, use SQL to select and summarize the audit data. If you follow the procedures discussed in “Setting up audit trail management” on page 276, the audit data is automatically archived to one or more tables in another database. For example, assume that the audit data resides in a table called audit_data in the audit_db database. To select audit records for tasks performed by “bob” on July 5, 1993, execute:

```
use audit_db
go
select * from audit_data
   where loginname = "bob"
   and eventtime like "Jul 5% 93"
go
```

This command requests audit records for commands performed in the pubs2 database by users with the system security officer role active:

```
select * from audit_data
   where extrainfo like "%sso_role%"
   and dbname = "pubs2"
go
```

This command requests audit records for all table truncations (event 64):

```
select * from audit_data
   where event = 64
go
```

To query the audit trail using the name of an audit event, use the audit_event_name function. For example, to request the audit records for all database creation events, enter:

```
select * from audit_data where audit_event_name(event)
   = "Create Database"
go
```

Understanding the audit tables

The system audit tables can be accessed only by a system security officer, who can read the tables by executing SQL commands. The only commands that are allowed on the system audit tables are select and truncate.

Table 8-3 describes the columns in all audit tables.

Table 8-3: Columns in each audit table

Column name	Datatype	Description
event	smallint	Type of event being audited. See Table 8-5 on page 301.
eventmod	smallint	More information about the event being audited. Indicates whether or not the event in question passed permission checks. Possible values are: • 0 = no modifier for this event. • 1 = the event passed permission checking. • 2 = the event failed permission checking.
spid	smallint	ID of the process that caused the audit record to be written.
eventtime	datetime	Date and time that the audited event occurred.
sequence	smallint	Sequence number of the record within a single event. Some events require more than one audit record.
suid	smallint	Server login ID of the user who performed the audited event.
dbid	int null	Database ID in which the audited event occurred, or in which the object, stored procedure, or trigger resides, depending on the type of event.
objid	int null	ID of the accessed object, stored procedure, or trigger.
xactid	binary(6) null	ID of the transaction containing the audited event. For a multi-database transaction, this is the transaction ID from the database where the transaction originated.
loginname	varchar(30) null	Login name corresponding to the suid.
dbname	varchar(30) null	Database name corresponding to the dbid.
objname	varchar(30) null	Object name corresponding to the objid.
objowner	varchar(30) null	Name of the owner of objid.
extrainfo	varchar(255) null	Additional information about the audited event. This column contains a sequence of items separated by semicolons. For details, see "Reading the extrainfo column" on page 300.
nodeid	tinyint	Server nodeid in a cluster where the event occurred.

Reading the *extrainfo* column

The extrainfo column contains a sequence of data separated by semicolons. The data is organized in the following categories.

Table 8-4: Information in the extrainfo column

Position	Category	Description
1	Roles	A list of active roles, separated by blanks.
2	Keywords or Options	The name of the keyword or option that was used for the event. For example, for the alter table command, the add column or drop constraint options might have been used. If multiple keywords or options are listed, they are separated by commas.

Position	Category	Description
3	Previous value	If the event resulted in the update of a value, this item contains the value prior to the update.
4	Current value	If the event resulted in the update of a value, this item contains the new value.
5	Other information	Additional security-relevant information that is recorded for the event.
6	Proxy information	The original login name if the event occurred while a set proxy was in effect.
7	Principal name	The principal name from the underlying security mechanism if the user's login is the secure default login, and the user logged in to Adaptive Server via unified login. The value of this item is NULL if the secure default login is not being used.

This example shows an extrainfo column entry for the event of changing an auditing configuration parameter.

```
sso_role;suspend audit when device full;1;0;;ralph;
```

This entry indicates that a system security officer changed suspend audit when device full from 1 to 0. There is no "other information" for this entry. The sixth category indicates that the user "ralph" was operating with a proxy login. No principal name is provided.

The other fields in the audit record give other pertinent information. For example, the record contains the server user ID (suid) and the login name (loginname).

Table 8-5 lists the values that appear in the event column, arranged by sp_audit option. The "Information in extrainfo" column describes information that might appear in the extrainfo column of an audit table, based on the categories described in Table 8-4.

Table 8-5: Values in event and extrainfo columns

Audit option	Command or access to be audited	event	Information in extrainfo
(Automatically audited event not controlled by an option)	Enabling auditing with: sp_configure auditing	73	—
(Automatically audited event not controlled by an option)	Disabling auditing with: sp_configure auditing	74	—
Unlocking Administrator's account	Disabling auditing with: sp_configure auditing	74	—
adhoc	User-defined audit record	1	extrainfo is filled by the text parameter of sp_addauditrecord

Audit option	Command or access to be audited	event	Information in extrainfo
alter	alter database	2	*Subcommand keywords:* alter maxhold alter size inmemory
	alter...modify owner *name_in_db*	124	*Subcommand keywords:* • For user-defined types: *owner. obj_name name_in_db* preserve permissions if the option is specified. • For objects: *name_in_db* preserve permission if the option is specified.
	alter...modify owner *login_name* as concrete_owner	124	*Subcommand keywords:* Do not apply to user-defined datatypes: For objects: *login_name* preserve permissions if the option is specified.
	alter table	3	*Subcommand keywords:* add/drop/modify column replace columns replace decrypt default replace/add decrypt default add constraint drop constraint If one or more encrypted columns are added, extrainfo contains the following, where *keyname* is the fully qualified name of the key: add/drop/modify column *column1*/*keyname1*, [,*column2*/*keyname2*]
bcp	bcp in	4	—
bind	sp_bindefault	6	*Other information:* Name of the default
	sp_bindmsg	7	*Other information:* Message ID
	sp_bindrule	8	*Other information:* Name of the rule
all, create	create database	9	Keywords or options: inmemory
cmdtext	All commands	92	Full text of command, as sent by the client

Audit option	Command or access to be audited	event	Information in extrainfo
create	create database	9	—
	create default	14	—
	create procedure	11	—
	create rule	13	—
	create table	10	For encrypted columns, extrainfo contains column names and keynames. EK *column1/keyname1*[,*column2 keyname2*] where EK is a prefix indicating that subsequent information refers to encryption keys and *keyname* is the fully qualified name of the key.
	create trigger	12	—
	create view	16	—
	create index	104	*Other information*: Name of the index
	create function	97	—
	sp_addmessage	15	*Other information*: Message number
dbaccess	Any access to the database by any user	17	*Keywords or options:* use cmd outside reference
dbcc	dbcc all keywords	81	*Keywords or options:* Any of the dbcc keywords such as checkstorage and the options for that keyword.
delete	delete from a table	18	*Keywords or options:* delete
	delete from a view	19	*Keywords or options:* delete

Audit option	Command or access to be audited	event	Information in extrainfo
disk	disk init	20	*Keywords or options:* disk init *Other information:* Name of the disk
	disk mirror	23	*Keywords or options:* disk mirror *Other information:* Name of the disk
	disk refit	21	*Keywords or options:* disk refit *Other information:* Name of the disk
	disk reinit	22	*Keywords or options:* disk reinit *Other information:* Name of the disk
	disk release	87	*Keywords or options:* disk release *Other information:* Name of the disk
	disk remirror	25	*Keywords or options:* disk remirror *Other information:* Name of the disk
	disk unmirror	24	*Keywords or options:* disk unmirror *Other information:* Name of the disk
	disk resize	100	*Keywords or options:* disk resize *Other information:* Name of the disk
drop	drop database	26	—
	drop default	31	—
	drop procedure	28	—
	drop table	27	—
	drop trigger	29	—
	drop rule	30	—
	drop view	33	—
	drop index	105	*Other information*: Index name
	drop function	98	—
	sp_dropmessage	32	*Other information:* Message number
dump	dump database	34	—
	dump transaction	35	—
encryption_key	sp_encryption	106	If password is set the first time: `ENCR_ADMIN system_encr_passwd password` ******** If the password is subsequently changed: `ENCR_ADMIN system_encr_passwd password` ******** ********

Audit option	Command or access to be audited	event	Information in extrainfo
	create encryption key	107	Keywords contain: algorithm name-bitlength/IV [random|NULL]/pad [random |NULL] user/system For example: `AES-128/IV RANDOM/PAD NULL USER`
	alter encryption key	108	`default/not default`
	drop encryption key	109	
	AEK modify encryption	118	modify encryption with user passwd | for user *username* {with login passwd | with user passwd | with *keyvalue*} [for recovery Note that *keyvalue* is displayed only for replication of alter encryption key modify encryption. For example, when user “stephen” modifies his key copy, the following information is saved: `MODIFY ENCRYPTION for user stephen WITH USER PASSWD`
	AEK add encryption	119	add encryption for user *user_name* for login association | recovery|with keyvalue] Note that *keyvalue* is displayed only for replication of alter encryption key add encryption.
	alter encryption key drop encryption	120	drop encryption [for recovery | for user *user_name* See the *Encrypted Columns Users Guide*.
	alter encryption key modify owner	121	modify owner [new owner *user_name*] See the *Encrypted Columns Users Guide*.
	alter encryption key recover key	122	recovery key [with *key_value*] with *keyvalue* is only used during replication of alter encryption key See the *Encrypted Columns Users Guide*.
errorlog	errorlog or errorlog_admin function	127	The parameters passed to errorlog_admin are logged to identify the subcommand: errorlog_admin (param1, param2,...).

Audit option	Command or access to be audited	event	Information in extrainfo
errors	Fatal error	36	*Other information:* *Error number*.*Severity*.*State*
	Non-fatal error	37	*Other information:* *Error number*.*Severity*.*State*
exec_procedure	Execution of a procedure	38	*Other information:* All input parameters
exec_trigger	Execution of a trigger	39	—
func_obj_access, func_dbaccess	Accesses to objects and databases via Transact-SQL functions. (Auditing must be enabled for the sa_role to audit functions).	86	—
grant	grant	40	Contains the full command text if available. Otherwise, contains the grantee and command type.
insert	insert into a table	41	*Keywords or option:* • If insert is used: insert • If select into is used: insert into followed by the fully qualified object name
	insert into a view	42	*Keywords or options*: insert
install	install	93	—
load	load database	43	—
	load transaction	44	—
login	Any login to the server	45	*Other information*: • Host name and IP address of the machine from which the login was performed. • *Error number.Severity.State* for failed logins.
login_locked	Login locked due to exceeding the configured number of failed login attempts	112	
logout	Any logouts from the server	46	*Other information:* Host name
mount	mount database	101	—
password	sp_passwordpolicy and all its actions except list.	115	Parameters for sp_passwordpolicy
quiesce	quiesce database	96	—
reference	Creation of references to tables	91	*Keywords or options*: reference *Other information:* Name of the referencing table
remove	remove java	94	—

Audit option	Command or access to be audited	event	Information in extrainfo
revoke	revoke	47	Contains the full command text if available. Otherwise, contains the grantee and command type.
rpc	Remote procedure call from another server	48	*Keywords or options:* Name of client program *Other information:* Server name, host name of the machine from which the RPC was executed.
	Remote procedure call to another server	49	*Keywords or options:* Procedure name
role locked	Role setting/unsetting	133	Role name and lock reason: • Role locked by suid by manually executing alter role *rolename* lock • Role locked by Adaptive Server due to failed role activation attempts reaching max failed_logins
security	connect to (CIS only)	90	*Keywords or options:* connect to
	online database	83	—
	proc_role function (executed from within a system procedure)	80	*Other information:* Required roles
	Regeneration of a password by an sso	76	*Keywords or options:* Setting SSO password *Other information:* Login name
	Role toggling	55	*Previous value:* on or off *Current value:* on or off *Other information:* Name of the role being set
	Server start	50	*Other information:* -d*masterdevicename* -i*interfaces file path* -S*servername* -e*errorfilename*
	sp_webservices	111	*Keywords or options:* deploy if deploying a web service. deploy_all if deploying all web services
	sp_webservices	111	*Keywords or options:* undeploy if undeploying a web service. undeploy_all if undeploying all web services
	Server shutdown	51	*Keywords or options:* shutdown
	set proxy or set session authorization	88	*Previous value:* Previous suid *Current value:* New suid

Audit option	Command or access to be audited	event	Information in extrainfo
	sp_configure	82	*Keywords or options:* SETCONFIG *Other information:* • If a parameter is being set: number of configuration parameter • If a configuration file is being used to set parameters: name of the configuration file
	sp_ssladmin administration enabled	99	Keywords contains SSL_ADMIN addcert, if adding a certification.
	Audit table access	61	—
	create login, drop login	103	*Keywords or options:* create login, drop login
	create, drop, alter, grant, or revoke role	85	*Keywords or options:* create, drop, alter, grant, or revoke role
	built-in functions	86	*Keywords or options:* Name of function
	Security command or access to be audited, specifically, starting Adaptive Server with -u option to unlock the administrator's account..	95	Other information contains 'Unlocking admin account'
	Changes to the LDAP state changes	123	*Keywords or options:* Primary URL state and secondary URL state • Previous value • Current value Additional information indicates whether the state change happened automatically or because of a manually entered command.
	The regeneration of asymmetric keypairs for network password encryption by the system or sp_passwordpolicy	117	Information in extrainfo
select	select from a table	62	*Keywords or options:* select into select readtext
	select from a view	63	*Keywords or options:* select into select readtext
setuser	setuser	84	*Other information:* Name of the user being set

Audit option	Command or access to be audited	event	Information in extrainfo
table_access	delete	18	*Keywords or options:* delete
	insert	41	*Keywords or options:* insert
	select	62	*Keywords or options:* select into select readtext
	update	70	*Keywords or options:* update writetext
truncate	truncate table	64	—
transfer_table	transfer table	136	transfer table
unbind	sp_unbindefault	67	—
	sp_unbindmsg	69	—
	sp_unbindrule	68	—
unmount	unmount database	102	—
	create manifest file	116	Information in extrainfo
update	update to a table	70	*Keywords or options:* update writetext
	update to a view	71	*Keywords or options:* update writetext
view_access	delete	19	*Keywords or options:* delete
	insert	42	*Keywords or options:* insert
	select	63	*Keywords or options:* select into select readtext
	update	71	*Keywords or options:* update writetext

Table 8-6 lists the values that appear in the event column, arranged by the audit event.

Table 8-6: Audit event values

Audit event ID	Command name	Audit event ID	Command name
1	ad hoc audit record	62	select table

Audit event ID	Command name	Audit event ID	Command name
2	alter database	63	select view
3	alter table	64	truncate table
4	bcp in	65	Reserved
5	Reserved	66	Reserved
6	bind default	67	unbind default
7	bind message	68	unbind rule
8	bind rule	69	unbind message
9	create database	70	update table
10	create table	71	update view
11	create procedure	72	Reserved
12	create trigger	73	auditing enabled
13	create rule	74	auditing disabled
14	create default	75	Reserved
15	create message	76	SSO changed password
16	create view	77	Reserved
17	access to database	78	Reserved
18	delete table	79	Reserved
19	delete view	80	role check performed
20	disk init	81	dbcc
21	disk refit	82	config
22	disk reinit	83	online database
23	disk mirror	84	setuser command
24	disk unmirror	85	UDR command
25	disk remirror	86	built-in function
26	drop database	87	Disk release
27	drop table	88	set SSA command
28	drop procedure	89	kill or terminate command
29	drop trigger	90	connect
30	drop rule	91	reference
31	drop default	92	command text
32	drop message	93	JCS install command
33	drop view	94	JCS remove command
34	dump database	95	Unlock admin account
35	dump transaction	96	quiesce database
36	Fatal error	97	create SQLJ function
37	Non-fatal error	98	drop SQLJ function
38	execution of stored procedure	99	SSL administration

Audit event ID	Command name	Audit event ID	Command name
39	Execution of trigger	100	disk resize
40	grant	101	mount database
41	insert table	102	unmount database
42	insert view	103	login command
43	load database	104	create index
44	load transaction	105	drop index
45	login	106	sp_encryption (encrypted column administration)
46	logout	107	create encryption key
47	revoke	108	Alter Encryption Key as/not default
48	rpc in	109	drop encryption key
49	rpc out	110 111	deploy user-defined web services undeploy user defined web services
50	server boot	112	login has been locked
51	server shutdown	113	quiesce hold security
52	Reserved	114	quiesce release
53	Reserved	115	Password administration
54	Reserved	116	create manifest file
55	role toggling	117	regenerate keypair
56	Reserved	118	alter encryptin key modify encryption
57	Reserved	119	alter encryption key add encryption
58	Reserved	120	alter encryption key drop encryption
59	Reserved	121	alter encryption key modify owner
60	Reserved	122	alter encryption key for key recovery
61	access to audit table	123	LDAP state changes
		124	alter...modify owner
		127	Errorlog administration
		136	transfer table

Monitoring failed login attempts

The audit option login_locked and the event Locked Login (value 112) record when a login account is locked due to exceeding the configured number of failed login attempts. This event is enabled when audit option login_locked is set. To set login_locked, enter:

```
sp_audit "login_locked","all","all","ON"
```

If the audit tables are full and the event cannot be logged, a message with the information is sent to the error log.

The host name and network IP address are included in the audit record. Monitoring the audit logs for the Locked Login event (number 112) helps to identify attacks on login accounts.

Auditing login failures

Although client applications may fail to login for many reasons, Adaptive Server does not provide them with any detailed information about the login failure. This is done to avoid giving information to malintentioned users attempting to crack passwords or otherwise breach Adaptive Server's authentication mechanisms.

However, as a system administrator, detailed information is useful for diagnosing Adaptive Server administrative or configuration problems, and it is useful to security officers for investigating attempts to breach security.

This enables auditing for all login failures:

```
sp_audit "login", "all", "all", "fail"
```

In order to provide a barrier to inappropriate use of the information, only a user granted the SSO role can access the audit trail information containing this sensitive information.

Adaptive Server audits login failures for the following conditions:

- For Adaptive Server started as a Windows Service, if the Sybase SQLServer service is paused (for example, by the Microsoft Management Console for Services).
- If a remote server attempts to establish a site handler for server-to-server RPCs, but insufficient resources (or any of the other conditions listed here) cause the site handler initialization to fail.

- Using Adaptive Server for Windows with the Trusted Login or Unified Login configuration, but the specified user is not a trusted administrator (that is, an authentication failure).
- Adaptive Server does not support the SQL interface requested by the client.
- A user is attempting to log into Adaptive Server when it is in single-user mode. In single-user mode, exactly one user with the sa_role is allowed to log in to Adaptive Server. Additional logins are prevented, even if they have the sa_role.
- The syslogins table in the master database fails to open, indicating the master database has an internal error.
- A client attempts a remote login, but sysremotelogins cannot be opened, or there is no entry for the specified user account and no guest account exists.
- A client attempts a remote login and, although it finds an entry referring to a local account for the specified user in sysremotelogins, the referenced local account does not exist.
- A client program requests a security session (for example, a Kerberos authentication), but the security session could not be established because:
  - The Adaptive Server security subsystem was not initialized at startup.
  - Insufficient memory resources for allocated structures.
  - The authentication negotiation failed.
- An authentication mechanism is not found for the specified user.
- The specified password was not correct.
- syslogins does not contain the required entry for the specified login.
- The login account is locked.
- Adaptive Server has reached its limit for the number of user connections.
- The configuration parameter unified login required is set, but the login has not been authenticated by the appropriate security subsystem.
- Adaptive Server’s network buffers are unavailable, or the requested packet size is invalid.
- A client application requests a host-based communication socket connection, but memory resources for the host-based communication buffers are not available.

- A shutdown is in progress, but the specified user does not have the sa role.
- Adaptive Server could not open the default database for a login, and this login does not have access to the master database.
- A client makes a high availability login fail over request, but the high availability subsystem is does not have a high availability session for this login, or the login is unable to wait for the fail over to complete.
- A client requests a high availability login setup, but the high availability subsystem is unable to create the session or is unable to complete the TDS protocol negotiations for the high availability session.
- Adaptive Server fails to setup tempdb for a login.
- TDS Login Protocol errors are detected.

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