

Oracle® Label Security

Administrator's Guide



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Preface

Oracle Label Security controls user access to (labeled) rows of a database. With Oracle Label Security in place, users with varying privilege levels automatically have (or are excluded from) the right to see or alter labeled rows of data.

Oracle Label Security Administrator's Guide describes how to use Oracle Label Security to protect sensitive data. It explains the basic concepts behind label-based security and provides examples to show how it is used.

- [Audience](#)
- [Documentation Accessibility](#)
- [Diversity and Inclusion](#)
- [Related Documentation](#)
- [Conventions](#)

Audience

Oracle Label Security Administrator's Guide is intended for database administrators (DBAs), application programmers, security administrators, system operators, and other Oracle users who perform the following tasks:

- Analyze application security requirements
- Create label-based security policies
- Administer label-based security policies
- Use label-based security policies

To use this document, you need a working knowledge of SQL and Oracle fundamentals. You should also be familiar with Oracle security features described in [Related Documentation](#). To use SQL*Loader, you must know how to use the file management facilities of your operating system.

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at <http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc>.

Access to Oracle Support

Oracle customer access to and use of Oracle support services will be pursuant to the terms and conditions specified in their Oracle order for the applicable services.

Diversity and Inclusion

Oracle is fully committed to diversity and inclusion. Oracle respects and values having a diverse workforce that increases thought leadership and innovation. As part of our initiative to build a more inclusive culture that positively impacts our employees, customers, and partners, we are working to remove insensitive terms from our products and documentation. We are also mindful of the necessity to maintain compatibility with our customers' existing technologies and the need to ensure continuity of service as Oracle's offerings and industry standards evolve. Because of these technical constraints, our effort to remove insensitive terms is ongoing and will take time and external cooperation.

Related Documentation

For more information, see these Oracle resources:

- *Oracle Database Concepts*
- *Oracle Database Security Guide*
- *Oracle Database Enterprise User Security Administrator's Guide*
- *Oracle Database Development Guide*
- *Oracle Database Administrator's Guide*
- *Oracle Database SQL Language Reference*
- *Oracle Database Reference*
- *Oracle Database Utilities*
- *Oracle Database Performance Tuning Guide*

Many of the examples in this book use the sample schemas. See *Oracle Database Sample Schemas* for information on how these schemas were created and how you can use them yourself.

Oracle Label Security Information

To download the product data sheet, frequently asked questions, links to the latest product documentation, product download, and other collateral, visit the Oracle website. <https://www.oracle.com/security/database-security/label-security/>

My Oracle Support

You can find information about security patches, certifications, and the support knowledge base by visiting My Oracle Support (formerly *OracleMetaLink*) at

<https://support.oracle.com>

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.

Convention	Meaning
<i>italic</i>	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
monospace	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

Changes in This Release for Oracle Label Security Administrator's Guide

This preface contains:

- [Changes in Oracle Database 23ai](#)
Oracle Label Security Administrator's Guide for Oracle Database 23ai has one new feature and two important desupported features.

Changes in Oracle Database 23ai

Oracle Label Security Administrator's Guide for Oracle Database 23ai has one new feature and two important desupported features.

- [Introduction of the LBAC_TRIGGER Schema for OLS DML Triggers](#)
Starting with Oracle Database release 23ai, the `LBAC_TRIGGER` schema is available to store DML triggers that Oracle Label Security uses.
- [Desupport of Traditional Auditing in Oracle Label Security](#)
Starting with Oracle Database 23ai, traditional auditing is desupported.
- [Desupport of Oracle Internet Directory with Oracle Label Security](#)
Starting with Oracle Database 23ai, the integration of Oracle Internet Directory (OID) with Oracle Label Security is desupported.

Introduction of the LBAC_TRIGGER Schema for OLS DML Triggers

Starting with Oracle Database release 23ai, the `LBAC_TRIGGER` schema is available to store DML triggers that Oracle Label Security uses.

In previous releases, these triggers were stored in the `LBACSYS` schema. The `LBAC_TRIGGER` schema provides greater security than the `LBACSYS` schema.

New triggers that you create will be automatically stored in the `LBAC_TRIGGER` schema. Triggers that were created in previous releases will still be in the `LBACSYS` schema after you upgrade to release 23ai. You will need to disable and reenble the OLS policies to migrate these triggers to the `LBAC_TRIGGER` schema.

Related Topics

- [Using the LBAC_TRIGGER Schema](#)
Managing OLS triggers when upgrading to Oracle Database 23ai and downgrading.

Desupport of Traditional Auditing in Oracle Label Security

Starting with Oracle Database 23ai, traditional auditing is desupported.

Unified auditing is the way forward to perform Oracle Label Security auditing. Unified auditing offers more flexibility to perform selective and effective auditing, which helps you focus on activities that really matter to your enterprise. Unified auditing has one single and secure unified trail, conditional policy for audit selectivity, and default predefined policies for simplicity. To improve security and compliance, Oracle strongly recommends that you use unified auditing.

Related Topics

- [Auditing Oracle Label Security Using Unified Auditing](#)
Oracle recommends that you migrate all your Oracle Label Security audit policies to unified auditing.

Desupport of Oracle Internet Directory with Oracle Label Security

Starting with Oracle Database 23ai, the integration of Oracle Internet Directory (OID) with Oracle Label Security is desupported.

The use of OID to store Oracle Label Security policies and labels is desupported with this release. no replacement for this feature is planned. If you are using this feature, then you must create a custom method to copy and store this information.

Part I

Getting Started with Oracle Label Security

Part I introduces the terms, concepts, and relationships that constitute the basic elements of Oracle Label Security.

- [Introduction to Oracle Label Security](#)
Oracle Label Security provides fine-grained access to individual table rows.
- [Understanding Data Labels and User Labels](#)
You should understand fundamental concepts of data labels and user labels.
- [Access Controls and Privileges](#)
Oracle provides access controls and privileges that determine the *type* of access users can have to labeled rows.

1

Introduction to Oracle Label Security

Oracle Label Security provides fine-grained access to individual table rows.

- [About Oracle Label Security](#)
Oracle Label Security controls the display, insert, and update of individual table rows using labels that are assigned to specific individual table rows and application users.
- [Benefits of Oracle Label Security](#)
Oracle Label Security provides several benefits for controlling row level management.
- [Who Has Privileges to Use Oracle Label Security?](#)
When you install Oracle Label Security with a database, the registration process creates an administrative user named `LBACSYS`, who has the `LBAC_DBA` role.
- [Duties of Oracle Label Security Administrators](#)
Oracle Label Security administrators have a set of package- and role-based privileges.
- [Components of Oracle Label Security](#)
An Oracle Label Security policy has a standard set of components.
- [Oracle Label Security Architecture](#)
The Oracle Label Security works with Oracle Database authentication to perform row level security.
- [Oracle Label Security Administrative Interfaces](#)
You can perform Oracle Label Security development and administrative tasks using either of two interfaces.
- [Oracle Label Security Demonstration File](#)
The `olsdemo.sql` file provides a demonstration on using Oracle Label Security.
- [Oracle Label Security Integration in a Multitenant Environment](#)
You can use Oracle Label Security in a multitenant environment.

1.1 About Oracle Label Security

Oracle Label Security controls the display, insert, and update of individual table rows using labels that are assigned to specific individual table rows and application users.

Oracle Label Security works by comparing the row label with a user's label authorizations to enable you to easily restrict sensitive information to only authorized users. This way, users with different authorization levels (for example, managers and sales representatives) can have access to different rows of data in a table. You can apply Oracle Label Security policies to one or more application tables. The design of Oracle Label Security is similar to Oracle Virtual Private Database (VPD). However, unlike VPD, Oracle Label Security provides the access mediation functions, data dictionary tables, and policy-based architecture out of the box, eliminating customized coding and providing a consistent label based access control model that can be used by multiple applications.

While Oracle Label Security was initially designed and developed to meet requirements in government and defense organizations, it has found widespread use for commercial business requirements.

Oracle Label Security software is installed by default, but not automatically enabled. You can enable Oracle Label Security in either SQL*Plus or by using the Oracle Database Configuration Assistant (DBCA). To administer Oracle Label Security, an Oracle Database administrator should create an Oracle Label Security administrative user and grant this user the `LBAC_DBA` role along with the necessary `EXECUTE` privileges on the Oracle Label Security `SA_*` packages. To manage Oracle Label Security, you can use either a set of PL/SQL packages and standalone functions at the command-line level or Oracle Enterprise Manager Cloud Control. To find information about Oracle Label Security policies, you can query `ALL_SA_*`, `DBA_SA_*`, or `USER_SA_*` data dictionary views.

1.2 Benefits of Oracle Label Security

Oracle Label Security provides several benefits for controlling row level management.

- It enables row level data classification and provides out-of-the-box access mediation based on the data classification and the user label authorization or security clearance.
- It enables you to assign label authorizations or security clearances to both database users and application users.
- It provides both APIs and a graphical user interface (in Oracle Enterprise Manager) for defining and storing data classification labels and user label authorizations.
- It integrates with Oracle Database Vault, Oracle Data Redaction, and Oracle Real Application Security, enabling the use of security clearances in those products.

1.3 Who Has Privileges to Use Oracle Label Security?

When you install Oracle Label Security with a database, the registration process creates an administrative user named `LBACSYS`, who has the `LBAC_DBA` role.

You can grant the `LBAC_DBA` role to any database user who will be responsible for managing Oracle Label Security policies. (This is the recommended way of administering Oracle Label Security, instead of using the `LBACSYS` user.) In addition, you can grant Oracle Label Security administrators the `EXECUTE` privilege for the Oracle Label Security packages, and privileges to manage individual Oracle Label Security policies.

As with other Oracle administrative user accounts, Oracle strongly recommends that you maintain two accounts for the `LBAC_DBA`. One account, the primary named user account, will be used on a day-to-day basis and the other account will be used as a backup account in case the password of the primary account is lost and must be reset.

1.4 Duties of Oracle Label Security Administrators

Oracle Label Security administrators have a set of package- and role-based privileges.

These privileges are:

- **Package-specific privileges:** Most of the Oracle Label Security PL/SQL packages, except for the public `SA_SESSION` and `SA_UTL` packages, require the `EXECUTE` privilege. The other packages are `SA_AUDIT_ADMIN`, `SA_COMPONENTS`, `SA_LABEL_ADMIN`, `SA_POLICY_ADMIN`, `SA_SYSDBA`, and `SA_USER_ADMIN`.
- **Role-based privileges:** The Oracle Label Security-specific roles are:
 - The `policy_DBA` role, which is created and granted to the user when they create a policy. For example, for a policy named `ols_hr_pol`, the role created is named

`ols_hr_pol_DBA`. This role adds a layer of granularity for access control for your site's Oracle Label Security policies.

- The `LBAC_DBA` role, which provides the `EXECUTE` privilege for the `SA_SYSDBA` package. This role is owned by the `LBACSYS` user account. The `SA_SYSDBA` package enables the user to create, alter, enable, disable, and drop Oracle Label Security policies.

You can use the Oracle Label Security package `EXECUTE` privilege grants along with grants of the `policy_DBA` role to achieve additional separation of duty. The packages are categorized based on different tasks. For example, you could grant the `EXECUTE` privilege on the `SA_COMPONENTS` and `SA_LABEL_ADMIN` packages to one user or role to manage label definitions, and then grant `EXECUTE` on `SA_USER_ADMIN` to a different user or role to manage user labels and privileges. Both of these users or roles must also be granted the `policy_DBA` role for the policies for which they are responsible. In this way, different users can be responsible for the management of different aspects of the policies for which they are responsible. For example, user `psmith` could be responsible for the label definitions of the `ols_hr_pol` policy, and user `tjones` could be responsible for the label definitions of the `ols_oe_pol` policy. However, user `psmith` cannot modify label definitions for the `ols_oe_pol` policy, nor can `tjones` modify the `ols_hr_pol` policy label definitions.

Related Topics

- [Oracle Label Security Packages](#)
Oracle Label Security packages provide a direct, command-line interface for ease of administration.

1.5 Components of Oracle Label Security

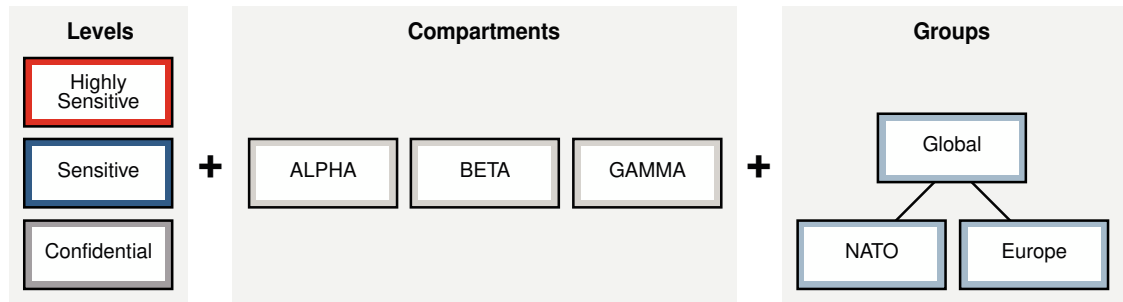
An Oracle Label Security policy has a standard set of components.

These components are as follows:

- **Labels.** Labels for data and users, along with authorizations for users and program units, govern access to specified protected objects. Labels are composed of the following:
 - **Levels.** Levels indicate the type of sensitivity that you want to assign to the row (for example, `SENSITIVE` or `HIGHLY SENSITIVE`). At least one level is mandatory.
 - **Compartments.** (Optional) Data can have the same level (for example, `Public`, `Confidential` and `Secret`), but can belong to different projects inside a company (for example, `ACME Merger` and `IT Security`). Compartments represent the projects in this example that help define more precise access controls. They are most often used in government environments.
 - **Groups.** (Optional) Groups identify organizations owning or accessing the data (for example, `UK`, `US`, `Asia`, `Europe`). Groups are used both in commercial and government environments, and frequently used in place of compartments due to their flexibility.
- **Policy.** A policy is a name associated with these labels, rules, authorizations, and protected tables.

For example, assume that a user has the `SELECT` privilege on an application table. As illustrated in [Figure 1-1](#), when the user runs a `SELECT` statement, Oracle Label Security evaluates each row selected to determine whether the user can access using the privileges and labels assigned to the user and the label on the row. You can configure Oracle Label Security to perform security checks on `UPDATE`, `DELETE`, and `INSERT` statements as well.

Figure 1-1 Oracle Label Security Label-Based Security

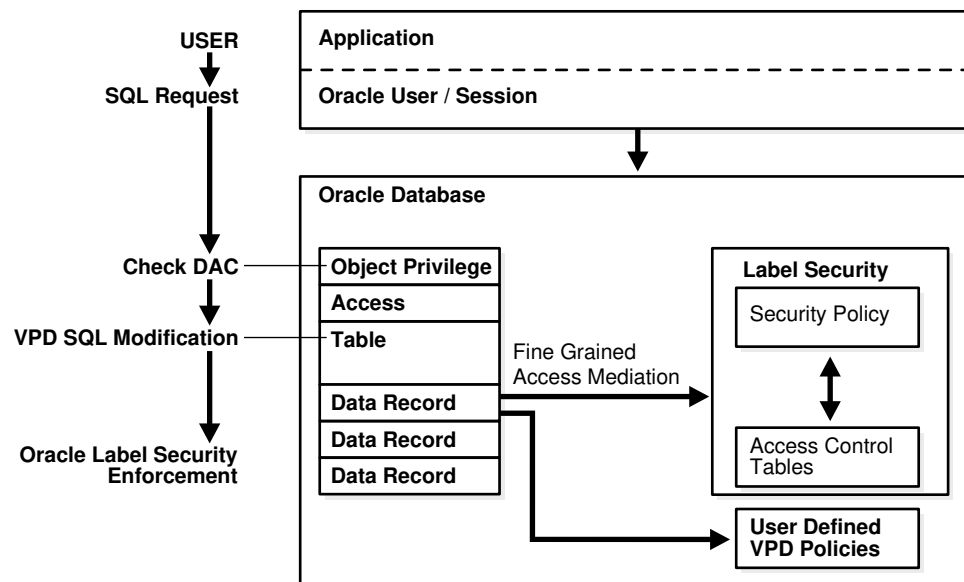


1.6 Oracle Label Security Architecture

The Oracle Label Security works with Oracle Database authentication to perform row level security.

Figure 1-2 shows how data is accessed under Oracle Label Security and the sequence of label security checks.

Figure 1-2 Oracle Label Security Architecture



In this scenario, the following actions take place:

1. An application user in an Oracle Database session sends a SQL request to query a table.
2. Oracle Database checks the user's data access control (DAC) privileges for performing a `SELECT` statement on the table.
3. If the user does have the appropriate privileges, then Oracle Database checks if there are any Oracle Virtual Private Database (VPD) policies attached to the table.
4. Oracle Database then checks if there are any Oracle Label Security policies that are assigned to the table.

5. Oracle Label Security then compares the labels that are assigned to individual rows with the users' label authorizations, allowing or denying access. The session label is based on label authorizations that are assigned to the user.

1.7 Oracle Label Security Administrative Interfaces

You can perform Oracle Label Security development and administrative tasks using either of two interfaces.

- [Oracle Label Security Packages](#)
Oracle Label Security packages provide a direct, command-line interface for ease of administration.
- [Oracle Enterprise Manager Cloud Control](#)
The Oracle Enterprise Manager Cloud Control Web interface can be used to administer Oracle Label Security.

1.7.1 Oracle Label Security Packages

Oracle Label Security packages provide a direct, command-line interface for ease of administration.

[Table 1-1](#) lists the available Oracle Label Security administrative packages.

Table 1-1 Oracle Label Security Administrative Packages

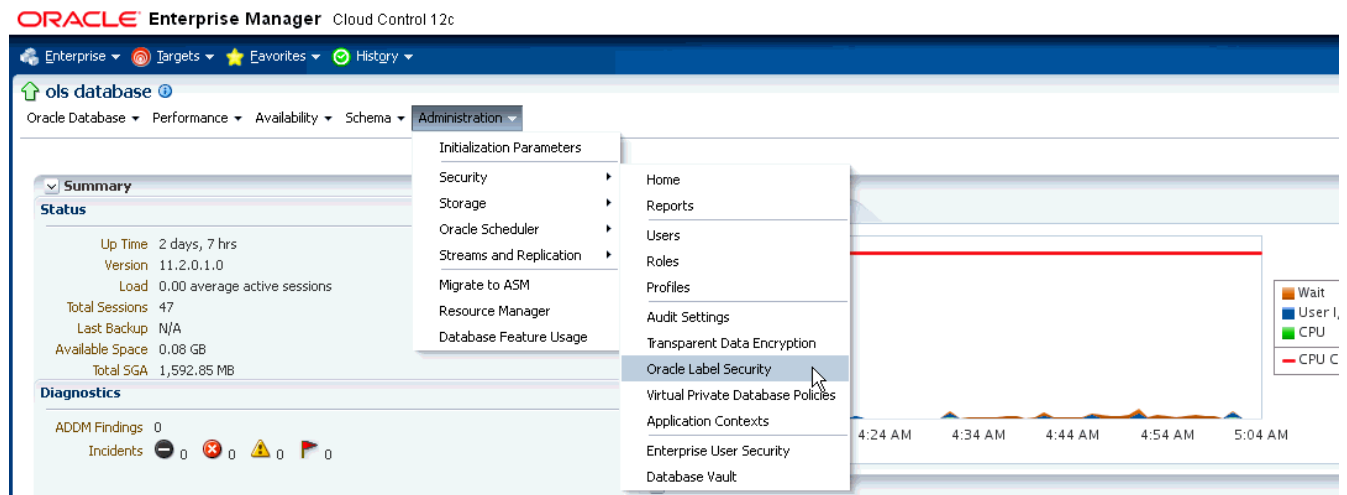
Package	Purpose
SA_SYSDBA	To create, alter, and drop Oracle Label Security policies See SA_SYSDBA Policy Management PL/SQL Package
SA_COMPONENTS	To define the levels, compartments, and groups for the policy See SA_COMPONENTS Label Components PL/SQL Package
SA_LABEL_ADMIN	To perform standard label policy administrative functions, such as creating labels See SA_LABEL_ADMIN Label Management PL/SQL Package
SA_POLICY_ADMIN	To apply policies to schemas and tables See SA_POLICY_ADMIN Policy Administration PL/SQL Package
SA_USER_ADMIN	To manage user authorizations for levels, compartments, and groups, as well as program unit privileges. Also to administer user privileges. See SA_USER_ADMIN.SET_USER_PRIVS and SA_USER_ADMIN.SET_PROG_PRIVS
SA_AUDIT_ADMIN	To set options to audit administrative tasks and use of privileges See SA_AUDIT_ADMIN Oracle Label Security Auditing PL/SQL Package
SA_SESSION	To change labels during a session within the authorizations set by the administrator See SA_SESSION Session Management PL/SQL Package
SA_UTL	A set of utility functions designed for use within PL/SQL programs to return information about the current values of the session security attributes, as numeric label values See SA_UTL PL/SQL Utility Functions and Procedures

1.7.2 Oracle Enterprise Manager Cloud Control

The Oracle Enterprise Manager Cloud Control Web interface can be used to administer Oracle Label Security.

Figure 1-3 illustrates the Oracle Enterprise Manager interface.

Figure 1-3 Using Enterprise Manager to Configure Oracle Label Security Policies



Related Topics

- [Managing Oracle Label Security from Enterprise Manager Cloud Control](#)
From Enterprise Manager Cloud Control, you use the Oracle Label Security pages to create and manage Oracle Label Security policies.
- [Registering and Logging in to Oracle Label Security](#)
Before using Oracle Label Security, you must register (configure) it with the database and then you can log in to Oracle Label Security.

1.8 Oracle Label Security Demonstration File

The `olsdemo.sql` file provides a demonstration on using Oracle Label Security.

This file show to create and develop an Oracle Label Security policy using the supplied packages. You can install this script from the `ORACLE_HOME/rdbms/demo` directory.

1.9 Oracle Label Security Integration in a Multitenant Environment

You can use Oracle Label Security in a multitenant environment.

 **Note:**

A multitenant container database is the only supported architecture in Oracle Database 21c and later releases. While the documentation is being revised, legacy terminology may persist. In most cases, "database" and "non-CDB" refer to a CDB or PDB, depending on context. In some contexts, such as upgrades, "non-CDB" refers to a non-CDB from a previous release.

In a multitenant environment, pluggable databases (PDBs) can be plugged in and out of a multitenant container database (CDB) or an application container.

- `rdbms/admin/catols.sql` script on the database to install the label-based framework, data dictionary, data types, and packages. This script creates the `LBACSYS` account.
- Because Oracle Label Security policies are scoped to individual PDBs, you can create individual policies for each PDB. A policy defined for a PDB can be enforced on the local tables and schema objects contained in the PDB.
- In a single CDB, there can be multiple PDBs, each configured with Oracle Label Security.
- You cannot create Oracle Label Security policies in the CDB root or the application root.
- You cannot enforce a local Oracle Label Security policy on a common CDB object or a common application object.
- You cannot assign Oracle Label Security policy labels and privileges to common users and application common users in a pluggable database.
- You cannot assign Oracle Label Security privileges to common procedures or functions and application common procedures or functions in a pluggable database.
- You can uninstall Oracle Label Security by using the `/rdbms/admin/catnools.sql` script.

Related Topics

- *Oracle Database Security Guide*

2

Understanding Data Labels and User Labels

You should understand fundamental concepts of data labels and user labels.

- [About Label-Based Security](#)
Label-based security provides a flexible way of controlling access to sensitive data.
- [About User Label and Privilege Management](#)
To manage user labels and privileges, you must have the `EXECUTE` privilege for the `SA_USER_ADMIN` package and be granted the `policy_DBA` role.
- [Label Components](#)
You should understand the elements that are used in labels.
- [Label Syntax and Type](#)
After label components are defined, you can create data labels by combining particular sets of level, compartments, and groups.
- [How Data Labels and User Labels Work Together](#)
A user can access data only within the range of their own label authorizations.
- [Administration of Labels](#)
Oracle Label Security provides administrative interfaces to define and manage the labels used in a database.

2.1 About Label-Based Security

Label-based security provides a flexible way of controlling access to sensitive data.

Oracle Label Security controls data access based on the identity and label of the user, and the sensitivity and label of the data. Label security adds protections beyond the discretionary access controls that determine the operations users can perform upon data in an *object*, such as a table or view.

[Table 2-1](#) shows the three dimensions with which an Oracle Label Security policy controls access to data.

Table 2-1 Oracle Label Security Data Dimensions

Data Dimension	Explanation
Data Labels	A data row label indicates the level and nature of the row's sensitivity and specifies the additional criteria that a user must meet to gain access to that row.
User Labels	A user label specifies that user's sensitivity level plus any compartments and groups that constrain the user's access to labeled data. Each user is assigned a range of levels, compartments, and groups, and each session can operate within that authorized range to access labeled data within that range.
Policy Privileges	Users can be given specific rights (privileges) to perform special operations or to access data beyond their label authorizations.

Note that the discussion here concerns *access to data*. The *access type* can be either reading or writing data.

When an Oracle Label Security policy is applied to a database table, a column is added to the table to contain each row's label. The administrator can choose to display or hide this column.

Related Topics

- [Access Controls and Privileges](#)
Oracle provides access controls and privileges that determine the *type* of access users can have to labeled rows.

2.2 About User Label and Privilege Management

To manage user labels and privileges, you must have the `EXECUTE` privilege for the `SA_USER_ADMIN` package and be granted the `policy_DBA` role.

The `SA_USER_ADMIN` package provides the procedures and functions to manage the Oracle Label Security user security attributes. It contains several procedures to manage user labels by component: that is, specifying user levels, compartments, and groups. For convenience, there are additional procedures that accept character string representations of full labels, rather than components. Note that the level, compartment, and group parameters use the short name defined for each component.

All of the label and privilege information is stored in Oracle Label Security data dictionary tables. When a user connects to the database, their session labels are established based on the information stored in the Oracle Label Security data dictionary.

Note that a user can be authorized under multiple policies.

Related Topics

- [SA_USER_ADMIN PL/SQL Package](#)
The `SA_USER_ADMIN` PL/SQL package manages user labels by label component.
- [SA_USER_ADMIN.SET_USER_PRIVS](#)
The `SA_USER_ADMIN.SET_USER_PRIVS` procedure sets policy-specific privileges for users.
- [Duties of Oracle Label Security Administrators](#)
Oracle Label Security administrators have a set of package- and role-based privileges.

2.3 Label Components

You should understand the elements that are used in labels.

- [Label Component Definitions and Valid Characters](#)
A label is a single attribute with multiple components.
- [Level Sensitivity Components](#)
A *level* is a ranking that denotes the sensitivity of the information it labels.
- [Compartment Components](#)
Compartments identify areas that describe the sensitivity of the labeled data, providing a finer level of granularity within a level.
- [Group Components](#)
Groups identify organizations owning or accessing the data, such as `EASTERN_REGION`, `WESTERN_REGION`, `WR_SALES`.
- [Industry Examples of Levels, Compartments, and Groups](#)
Oracle Label Security levels, compartments, groups are designed to be implemented in various industries.

2.3.1 Label Component Definitions and Valid Characters

A label is a single attribute with multiple components.

All labels must contain a level component, but the compartment and group components are optional. An administrator must define the label components before creating labels.

Labels indicate the sensitivity of data records and the sensitivity authorization for a user. For the user to be able to view the data, a user label must take precedence over the data label.

Although the administrator defines both long and short names for the label components, only the short form of the name is displayed upon retrieval. When users manipulate the labels, they use only the short form of the component names. Examples of short forms are illustrated in the **Examples** column of the following table.

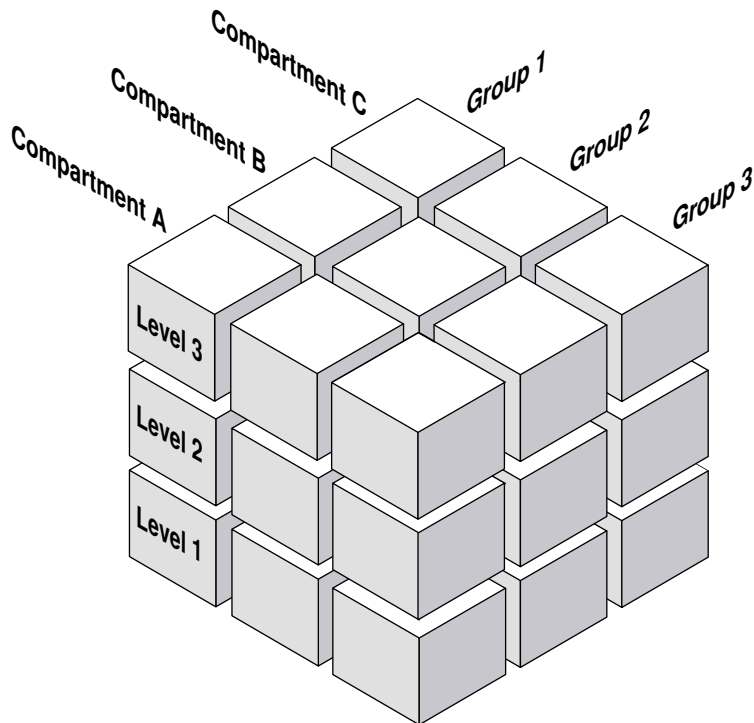
Table 2-2 Sensitivity Label Components

Component	Description	Examples
Level	A label must include a level component. A specification for the sensitivity level is used to indicate the data's sensitivity and the maximum sensitivity level authorized for the user. The sensitivity levels are numerically ordered.	<ul style="list-style-type: none">• C (for CONFIDENTIAL) (1)• S (for SENSITIVE) (2)• HS (for HIGHLY_SENSITIVE) (3)
Compartments	Zero or more components associated with the label	<ul style="list-style-type: none">• FINCL (for FINANCIAL)• CHEM (for CHEMICAL)• OP (for OPERATIONAL)
Groups	Zero or more groups in a data label indicate the groups that are allowed to access the data. The user label contains the groups a user is authorized to. Groups are typically geographical or organizational and can be in a hierarchy as well.	<ul style="list-style-type: none">• ER (for EASTERN_REGION)• WR (for WESTERN_REGION)

Valid characters for specifying all label components include alphanumeric characters, underscores, and spaces. (Leading and trailing spaces are ignored.)

The following figure illustrates the three dimensions in which data can be logically classified, using levels, compartments, and groups.

Figure 2-1 Data Categorization with Levels, Compartments, and Groups



2.3.2 Level Sensitivity Components

A *level* is a ranking that denotes the sensitivity of the information it labels.

The more sensitive the information, the higher its level. The less sensitive the information, the lower its level.

Every label must include one level. Oracle Label Security permits defining up to 10,000 levels in a policy. For each level, the Oracle Label Security administrator defines a numeric form, a long character form, and the required short character form.

[Table 2-2](#) shows examples of levels.

Table 2-3 Level Example

Numeric Form	Long Form	Short Form
40	HIGHLY_SENSITIVE	HS
30	SENSITIVE	S
20	CONFIDENTIAL	C
10	PUBLIC	P

[Table 2-4](#) shows different ways of specifying levels.

Table 2-4 Forms of Specifying Levels

Form	Explanation
Numeric form, also called "tag"	The numeric form of the level can range from 0 to 9999. Sensitivity is ranked by this numeric value, so you must assign higher numbers to levels that are more sensitive, and lower numbers to levels that are less sensitive. In Table 2-3 , 40 (HIGHLY_SENSITIVE) is a higher level than 30, 20, and 10. Administrators should avoid using sequential numbers for the numeric form of levels. A good strategy is to use even increments (such as 50 or 100) between levels. You can then insert additional levels between two preexisting levels, at a later date.
Long form	The long form of the level name can contain up to 80 characters.
Short form	The short form can contain up to 30 characters.

Although the administrator defines both long and short names for the level (and for each of the other label components), only the short form of the name is displayed upon retrieval of the records when the Oracle Label Security policy is in effect. When users manipulate the labels, they use only the short form of the component names.

Other sets of levels that users commonly define include TOP_SECRET, SECRET, CONFIDENTIAL, and UNCLASSIFIED or TRADE_SECRET, PROPRIETARY, COMPANY_CONFIDENTIAL, and PUBLIC_DOMAIN.

If only levels are used, a level 40 user (in this example) can access or alter any data row whose level is 40 or less.

**Note:**

All levels and labels (including TOP_SECRET, SECRET, CONFIDENTIAL, and so on) in this guide, are used as illustrations only.

2.3.3 Compartment Components

Compartments identify areas that describe the sensitivity of the labeled data, providing a finer level of granularity within a level.

Compartments associate the data with one or more security areas. All data related to a particular project can be labeled with the same compartment.

[Table 2-5](#) shows examples of compartments.

Table 2-5 Compartment Example

Numeric Form	Long Form	Short Form
85	FINANCIAL	FINCL
65	CHEMICAL	CHEM
45	OPERATIONAL	OP

[Table 2-6](#) shows different ways of specifying compartments.

Table 2-6 Forms of Specifying Compartments

Form	Explanation
Numeric form	<p>The numeric form can range from 0 to 9999. It is unrelated to the numbers used for the levels. The numeric form of the compartment does not indicate greater or less sensitivity. Instead, it controls the display order of the short form compartment name in the label character string. For example, assume a label is created that has all three compartments listed in Table 2-5, and a level of SENSITIVE, whose short form is S. When this label is displayed in string format, it looks like the following, meaning SENSITIVE: OPERATIONAL, CHEMICAL, FINANCIAL:</p> <pre>S:OP,CHEM,FINCL</pre> <p>The display order follows the order of the numbers assigned to the compartments: 45 is lower than 65, and 65 is lower than 85. By contrast, if the number assigned to the FINCL compartment were 5, the character string format of the label would look like this:</p> <pre>S:FINCL,OP,CHEM</pre>
Long form	The long form of the compartment name can have up to 80 characters.
Short form	The short form can contain up to 30 characters.

Compartments are optional. A label can contain zero or more compartments. Oracle Label Security permits defining up to 10,000 compartments.

Not all labels need to have compartments. For example, you can specify HIGHLY_SENSITIVE and CONFIDENTIAL levels with no compartments, and a SENSITIVE level that does contain compartments.

When you analyze the sensitivity of data, you may find that some compartments are only useful at specific levels.

The following figure shows how compartments can be used to categorize data.

Figure 2-2 Label Matrix

		Compartments		
Levels	HS	FINCL	CHEM	OP
	S	FINCL		OP
	P			OP

Here, compartments FINCL, CHEM, and OP are used with the level HIGHLY_SENSITIVE (40). The label HIGHLY_SENSITIVE:FINCL, CHEM indicates a level of 40 with the two named compartments. Compartment FINCL is not more sensitive than CHEM, nor is CHEM more sensitive than FINCL. Note also that some data in the protected table may not belong to any compartment.

If compartments are specified, then a user whose level would normally permit access to a row's data will nevertheless be prevented from such access unless the user's label also contains all the compartments appearing in that row's label.

2.3.4 Group Components

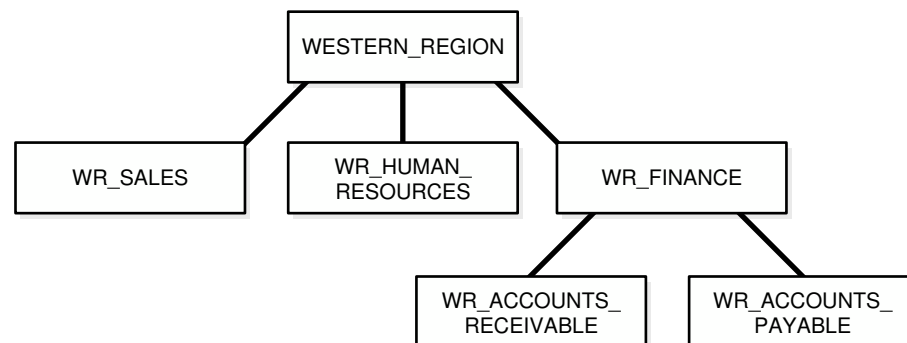
Groups identify organizations owning or accessing the data, such as `EASTERN_REGION`, `WESTERN_REGION`, `WR_SALES`.

All data pertaining to a certain department can have that department's group in the label. Groups are useful for the controlled dissemination of data and for timely reaction to organizational change. When a company reorganizes, data access can change right along with the reorganization.

Groups are hierarchical. You can label data based upon your organizational infrastructure. A group can thus be associated with a parent group.

Figure 2-3 shows how you can define a set of groups corresponding to the following organizational hierarchy.

Figure 2-3 Group Example



The `WESTERN_REGION` group includes three subgroups: `WR_SALES`, `WR_HUMAN_RESOURCES`, and `WR_FINANCE`. The `WR_FINANCE` subgroup is subdivided into `WR_ACCOUNTS_RECEIVABLE` and `WR_ACCOUNTS_PAYABLE`.

Table 2-7 shows how the organizational structure in this example can be expressed in the form of Oracle Label Security groups. Notice that the numeric form assigned to the groups affects display order only. The administrator specifies the hierarchy (that is, the parent/child relationships) separately.

Table 2-7 Group Example

Numeric Form	Long Form	Short Form	Parent Group
1000	<code>WESTERN_REGION</code>	<code>WR</code>	
1100	<code>WR_SALES</code>	<code>WR_SAL</code>	<code>WR</code>
1200	<code>WR_HUMAN_RESOURCES</code>	<code>WR_HR</code>	<code>WR</code>
1300	<code>WR_FINANCE</code>	<code>WR_FIN</code>	<code>WR</code>
1310	<code>WR_ACCOUNTS_PAYABLE</code>	<code>WR_AP</code>	<code>WR_FIN</code>
1320	<code>WR_ACCOUNTS_RECEIVABLE</code>	<code>WR_AR</code>	<code>WR_FIN</code>

Table 2-8 shows different ways of specifying groups.

Table 2-8 Forms of Specifying Groups

Form	Explanation
Numeric form	<p>The numeric form of the group can range from 0 to 9999, and it must be unique for each policy.</p> <p>The numeric form does not indicate any kind of ranking. It does not indicate a parent-child relationship, or greater or less sensitivity. It only controls the display order of the short form group name in the label character string.</p> <p>For example, assume that a label is created that has the level <code>SENSITIVE</code>, the compartment <code>CHEMICAL</code>, and the groups <code>WESTERN_REGION</code> and <code>WR_HUMAN_RESOURCES</code> as listed in Table 2-7. When displayed in string format, the label looks like this:</p> <pre>S:CHEM:WR,WR_HR</pre> <p><code>WR</code> is displayed before <code>WR_HR</code> because 1000 comes before 1200.</p>
Long form	The long form of the group name can contain up to 80 characters.
Short form	The short form can contain up to 30 characters.

Groups are optional; a label can contain zero or more groups. Oracle Label Security permits defining up to 10,000 groups.

All labels need not have groups. When you analyze the sensitivity of data, you may find that some groups are only used at specific levels. For example, you can specify `HIGHLY_SENSITIVE` and `CONFIDENTIAL` labels with no groups, and a `SENSITIVE` label that does contain groups.

Related Topics

- [Releasability Using Inverse Groups](#)
Oracle Label Security can implement the releasability using inverse groups.

2.3.5 Industry Examples of Levels, Compartments, and Groups

Oracle Label Security levels, compartments, groups are designed to be implemented in various industries.

[Table 2-9](#) illustrates the flexibility of Oracle Label Security levels, compartments, and groups, by listing typical ways in which they can be implemented in various industries.

Table 2-9 Typical Levels, Compartments, and Groups, by Industry

Industry	Levels	Compartments	Groups
Business to Business	<code>TRADE_SECRET</code>	<code>MARKETING</code>	<code>AJAX_CORP</code>
	<code>PROPRIETARY</code>	<code>FINANCIAL</code>	<code>BILTWELL_CO</code>
	<code>COMPANY_CONFIDENTIAL</code>	<code>SALES</code>	<code>ACME_INC</code>
	<code>PUBLIC</code>	<code>PERSONNEL</code>	<code>ERSATZ_LTD</code>
Financial Services	<code>ACQUISITIONS</code>	<code>INSURANCE</code>	<code>CLIENT</code>
	<code>CORPORATE</code>	<code>EQUITIES</code>	<code>TRUSTEE</code>
	<code>CLIENT</code>	<code>TRUSTS</code>	<code>BENEFICIARY</code>
	<code>OPERATIONS</code>	<code>COMMERCIAL_LOANS</code>	<code>MANAGEMENT</code>
		<code>CONSUMER_LOANS</code>	<code>STAFF</code>

Table 2-9 (Cont.) Typical Levels, Compartments, and Groups, by Industry

Industry	Levels	Compartments	Groups
Judicial	NATIONAL_SECURITY	CIVIL	ADMINISTRATION
	SENSITIVE	CRIMINAL	DEFENSE
	PUBLIC		PROSECUTION COURT
Health Care	PRIMARY_PHYSICIAN	PHARMACEUTICAL	CDC
	PATIENT_CONFIDENTIAL	INFECTIOUS_DISEASES	RESEARCH
	PATIENT_RELEASE		NURSING_STAFF HOSPITAL_STAFF
Defense	TOP_SECRET	ALPHA	UK
	SECRET	DELTA	NATO
	CONFIDENTIAL	SIGMA	SPAIN
	UNCLASSIFIED		

2.4 Label Syntax and Type

After label components are defined, you can create data labels by combining particular sets of level, compartments, and groups.

You can use the Oracle Enterprise Manager graphical user interface or a command line procedure. Character string representations of labels use the following syntax:

```
LEVEL:COMPARTMENT1, . . . ,COMPARTMENTn:GROUP1, . . . ,GROUPn
```

The text string specifying the label can have a maximum of 4,000 characters, including alphanumeric characters, spaces, and underscores. The labels are case-insensitive. You can enter them in uppercase, lowercase, or mixed case, but the string is stored in the data dictionary and displayed in uppercase. A colon is used as the delimiter between components. A comma is used as a delimiter between different entries (compartment or group) within a component. It is not necessary to enter trailing delimiters in this syntax.

For example, you can create valid labels such as these:

```
SENSITIVE:FINANCIAL,CHEMICAL:EASTERN_REGION,WESTERN_REGION  
CONFIDENTIAL:FINANCIAL:VP_GRP  
SENSITIVE  
HIGHLY_SENSITIVE:FINANCIAL  
SENSITIVE::WESTERN_REGION
```

When a valid data label is created, two additional things occur:

- The label is automatically designated as a valid data label. This functionality limits the labels that can be assigned to data. Most users, however, prefer to create the labels manually in order to limit data label proliferation.
- A numeric label tag is associated with the text string representing the label. It is this label tag, rather than the text string, that is stored in the policy label column of the protected table.

 **Note:**

The dynamic creation of valid data labels uses the `TO_DATA_LABEL` function. Its usage should be tightly controlled.

Related Topics

- [Inserting Labels Using TO_DATA_LABEL](#)
The `TO_DATA_LABEL` function can generate new labels dynamically.
- [How Policy Label Column and Label Tags Work](#)
You should understand how policy label columns in a table or schema are created and filled.
- [Label Tags](#)
You can create label tags that represent the label components automatically or manually.

2.5 How Data Labels and User Labels Work Together

A user can access data only within the range of their own label authorizations.

A user has the following:

- Maximum and minimum levels
- A set of authorized compartments
- A set of authorized groups (and, implicitly, authorization for any subgroups)

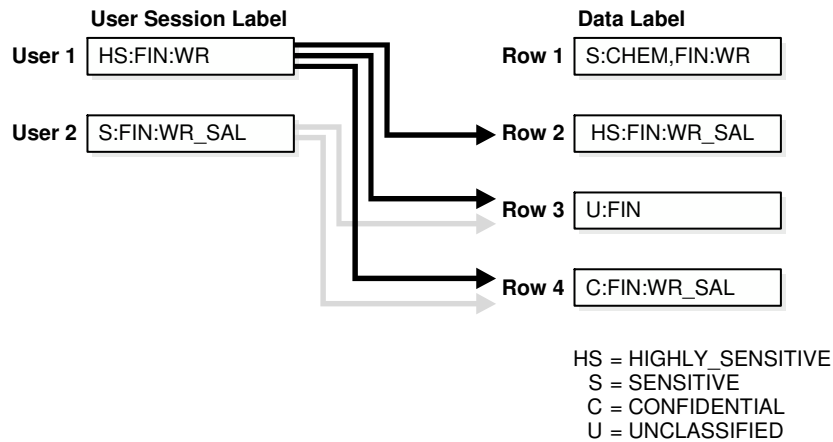
For example, suppose you have the following levels:

- `HIGHLY_SENSITIVE`, with the numeric form 40
- `SENSITIVE`, with the numeric form 30
- `CONFIDENTIAL`, with the numeric form 20
- `PUBLIC`, with the numeric form 10

If a user is assigned a maximum level of `SENSITIVE`, then the user potentially has access to `SENSITIVE`, `CONFIDENTIAL`, and `PUBLIC` data. The user has no access to `HIGHLY_SENSITIVE` data because this level is too high.

[Figure 2-4](#) shows how data labels and user labels work together to provide access control in Oracle Label Security. While data labels are discrete, user labels are inclusive. Depending upon authorized compartments and groups, a user can potentially access data corresponding to all levels within their range.

Figure 2-4 Example: Data Labels and User Labels

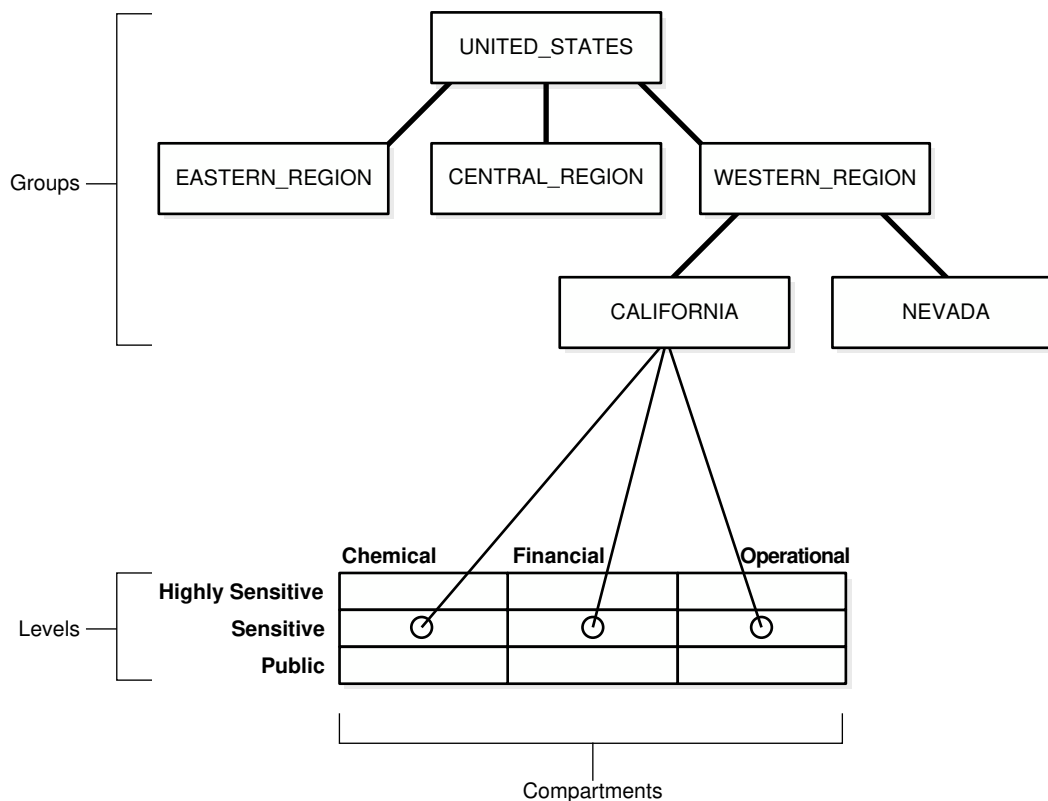


As shown in the figure, User 1 can access the rows 2, 3, and 4 because their maximum level is HS. They have access to the FIN compartment, and their access to group WR hierarchically includes group WR_SAL. They cannot access row 1 because they does not have the CHEM compartment. (A user must have authorization for *all* compartments in a row's data label to be able to access that row.)

User 2 can access rows 3 and 4. This user's maximum level is s, which is less than HS in row 2. Although the user has access to the FIN compartment, they only have authorization for group WR_SAL. So, they cannot access row 1.

Figure 2-5 shows how data pertaining to an organizational hierarchy fits into data levels and compartments.

Figure 2-5 How Label Components Interrelate



For example, the `UNITED_STATES` group includes three subgroups: `EASTERN_REGION`, `CENTRAL_REGION`, and `WESTERN_REGION`. The `WESTERN_REGION` subgroup is further subdivided into `CALIFORNIA` and `NEVADA`. For each group and subgroup, there may be data belonging to some of the valid compartments and levels within the database. So, there may be `SENSITIVE` data that is `FINANCIAL`, within the `CALIFORNIA` subgroup.

Note that data is generally labeled with a single group whereas users' labels form a hierarchy. If users have a particular group, then that group may implicitly include child groups. This way a user associated with the `UNITED_STATES` group has access to all data, but a user associated with `CALIFORNIA` would have access to data pertaining to only that subgroup.

2.6 Administration of Labels

Oracle Label Security provides administrative interfaces to define and manage the labels used in a database.

You define labels in Oracle Database using Oracle Label Security PL/SQL packages or by using Oracle Enterprise Manager. Initially, an administrator must define the levels, compartments, and groups that compose the labels, and then, the user can define the set of valid data labels for the contents of the database.

An administrator can apply a policy to individual tables in the database or to entire application schemas. Finally, the administrator assigns to each database user the label components (and privileges, if needed) required for the user's job function.

3

Access Controls and Privileges

Oracle provides access controls and privileges that determine the *type* of access users can have to labeled rows.

- [Access Mediation](#)
To access data protected by an Oracle Label Security policy, a user must have authorizations based on the labels defined for the policy.
- [How the Session Label and Row Label Work](#)
It is important to understand session labels and row labels.
- [How User Authorizations Work](#)
Oracle Label Security provides authorizations set by the Oracle Label Security administrator and authorizations set by computed session labels.
- [Evaluation of Labels for Access Mediation](#)
Oracle Label Security evaluates labels by comparing the user's label components to the row's label components.
- [Oracle Label Security Privileges](#)
Oracle Label Security provides a set of system privileges, object privileges, and policy privileges.
- [Working with Multiple Oracle Label Security Policies](#)
You can use multiple Oracle Label Security policies in both a single database environments and in a distributed environments.

Related Topics

- [Understanding Data Labels and User Labels](#)
You should understand fundamental concepts of data labels and user labels.

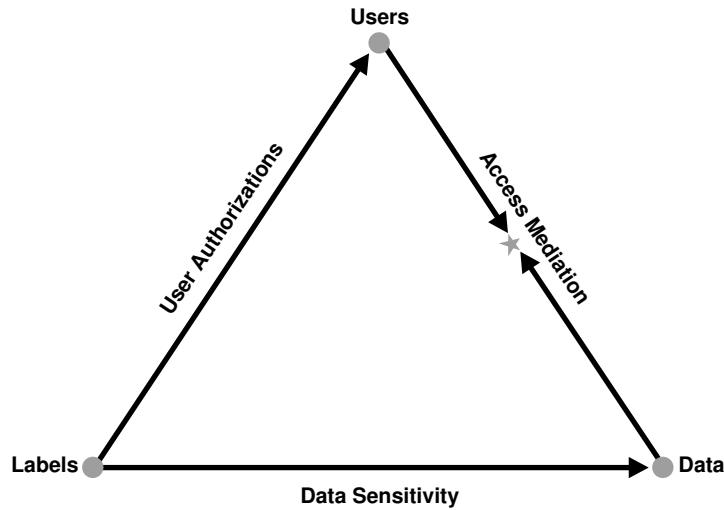
3.1 Access Mediation

To access data protected by an Oracle Label Security policy, a user must have authorizations based on the labels defined for the policy.

The following figure illustrates the relationships between users, data, and labels.

- Data labels specify the sensitivity of data rows.
- User labels provide the appropriate authorizations to users.
- Access mediation between users and rows of data depends on users' labels.

Figure 3-1 Relationships Between Users, Data, and Label



 **Note:**

Oracle Label Security enforcement options affect how access controls apply to tables and schemas. This chapter assumes that all policy enforcement options are in effect.

Related Topics

- [Oracle Label Security Policy Enforcement Options](#)
Oracle Label Security provides a set of policy enforcement options.

3.2 How the Session Label and Row Label Work

It is important to understand session labels and row labels.

- [The Session Label](#)
Each Oracle Label Security user has authorizations that include special components.
- [The Row Label](#)
When a user writes data without specifying its label, a default *row label* is assigned automatically, using the user's session label.
- [Session Label Example](#)
The session label and the row label can fall anywhere within the range of the user's level, compartment, and group authorizations.

3.2.1 The Session Label

Each Oracle Label Security user has authorizations that include special components.

- A maximum and minimum level
- A set of authorized compartments
- A set of authorized groups
- For each compartment and group, a specification of read-only access, or read/write access

The administrator also specifies the user's initial session label when setting up these authorizations for the user. The *session label* is the particular combination of levels, compartments, and groups at which a user works at any given time. The user can change the session label to any combination of components for which the user is authorized.

Related Topics

- [SA_SESSION Session Management PL/SQL Package](#)
The `SA_SESSION` PL/SQL package manages session behavior for user authorizations.

3.2.2 The Row Label

When a user writes data without specifying its label, a default *row label* is assigned automatically, using the user's session label.

However, the user can set the label for the written row, within certain restrictions on the components of the label they specify. The level of this label can be set to any level within the range specified by the administrator. For example, it can be set to the level of the user's current session label down to the user's minimum level. However, the compartments and groups for this row's new label are more restricted. The new label can include only those compartments and groups contained in the current session label and, among those, only the ones for which the user has write access.

When the administrator sets up the user authorizations, they also specify an initial default row label.

Related Topics

- [SA_USER_ADMIN PL/SQL Package](#)
The `SA_USER_ADMIN` PL/SQL package manages user labels by label component.
- [SA_SESSION Session Management PL/SQL Package](#)
The `SA_SESSION` PL/SQL package manages session behavior for user authorizations.

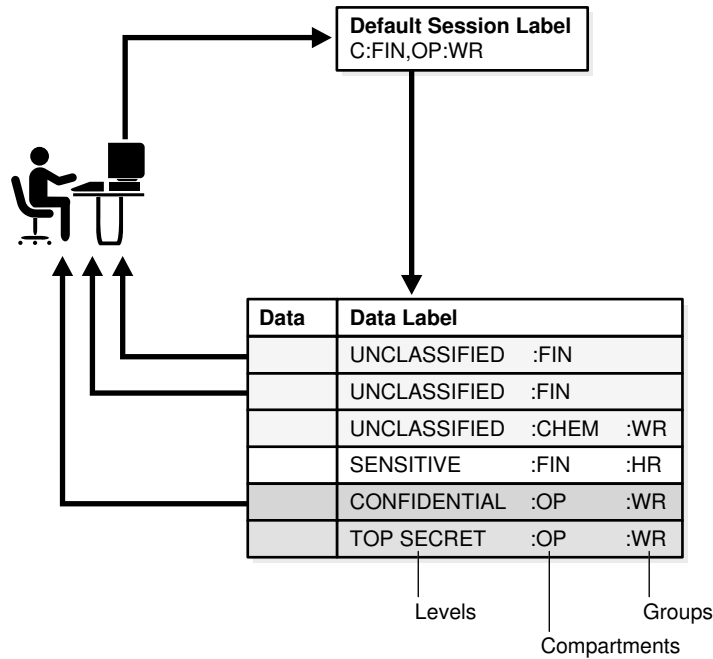
3.2.3 Session Label Example

The session label and the row label can fall anywhere within the range of the user's level, compartment, and group authorizations.

In the following figure, the user's maximum level is `SENSITIVE` and the minimum level is `UNCLASSIFIED`. However, the user's default session label is `C:FIN,OP:WR`. In this example, the administrator has set the user's session label so that the user connects to the database at the `CONFIDENTIAL` level.

Similarly, although the user is authorized for compartments `FIN` and `OP`, and group `WR`, the administrator could set the session label so that the user connects with only compartment `FIN` and group `WR`.

Figure 3-2 User Session Label



Related Topics

- [SA_USER_ADMIN.SET_COMPARTMENTS](#)
The `SA_USER_ADMIN.SET_COMPARTMENTS` procedure assigns compartments to a user and identifies default values for the user's session label and row label.
- [SA_USER_ADMIN.ALTER_COMPARTMENTS](#)
The `SA_USER_ADMIN.ALTER_COMPARTMENTS` procedure changes the write access, default label indicator, and row label indicator for the specified compartments.

3.3 How User Authorizations Work

Oracle Label Security provides authorizations set by the Oracle Label Security administrator and authorizations set by computed session labels.

- [Authorizations Set by the Administrator](#)
The administrator explicitly sets authorizations for levels, compartments, and groups.
- [Computed Session Labels](#)
Oracle Label Security automatically computes a number of labels based on the value of the session label.

3.3.1 Authorizations Set by the Administrator

The administrator explicitly sets authorizations for levels, compartments, and groups.

- [Authorized Levels](#)
The administrator explicitly sets the level authorization for an Oracle Label Security policy.
- [Authorized Compartments](#)
The administrator specifies the list of compartments that a user can place in their session label.

- [Authorized Groups](#)
You must specify a list of groups that a user can place in a session label and grant write access for each group.

3.3.1.1 Authorized Levels

The administrator explicitly sets the level authorization for an Oracle Label Security policy.

[Table 3-1](#) lists authorized levels that the administrator can set.

Table 3-1 Authorized Levels Set by the Administrator

Authorization	Meaning
User Max Level	The maximum ranking of sensitivity that a user can access during read and write operations
User Min Level	The minimum ranking of sensitivity that a user can access during write operations. The User Max Level must be equal to or greater than the User Min Level.
User Default Level	The level that is assumed by default when connecting to Oracle Database
User Default Row Level	The level that is used by default when inserting data into Oracle Database

For example, in Oracle Enterprise Manager, the administrator might set the following level authorizations for user Joe:

Type	Short Name	Long Name	Description
Maximum	HS	HIGHLY_SENSITIVE	User's highest level
Minimum	P	PUBLIC	User's lowest level
Default	C	CONFIDENTIAL	User's default level
Row	C	CONFIDENTIAL	Row level on INSERT

3.3.1.2 Authorized Compartments

The administrator specifies the list of compartments that a user can place in their session label.

The administrator must explicitly give write access to the user for each compartment. A user cannot directly insert, update, or delete a row that contains a compartment that they do not have authorization to write.

For example, in Oracle Enterprise Manager, the administrator might set the following compartment authorizations for user Joe:

Short Name	Long Name	WRITE	DEFAULT	ROW
CHEM	CHEMICAL	YES	YES	NO
FINCL	FINANCIAL	YES	YES	NO
OP	OPERATIONAL	YES	YES	YES

In [Figure 3-3](#), the row designation indicates whether the compartment should be used as part of the default row label for newly inserted data. Note also that the policy option must be in effect for this setting to be valid.

Figure 3-3 Setting Up Authorized Compartments In Enterprise Manager

Compartments

Specify zero or more compartments to be assigned to the user.

[Add](#)

[Remove](#)

[Select All](#) | [Select None](#)

Select	Short Name	Write	Default	Row
<input checked="" type="checkbox"/>	CHEM	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	FINCL	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	OP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

3.3.1.3 Authorized Groups

You must specify a list of groups that a user can place in a session label and grant write access for each group.

For example, in Oracle Enterprise Manager, the administrator might set the following group authorizations:

Short Name	Long Name	WRITE	DEFAULT	ROW	Parent
WR_HR	WR_HUMAN_RESOURCES	YES	YES	YES	WR
WR_AP	WR_ACCOUNTS_PAYABLE	YES	YES	NO	WR_FIN
WR_AR	WR_ACCOUNTS_RECEIVABLE	YES	YES	NO	WR_FIN

In [Figure 3-4](#), the row designation indicates whether the group should be used as part of the default row label for newly inserted data. Note also that the LABEL_DEFAULT policy option must be in effect for this setting to be valid.

Figure 3-4 Setting Up Authorized Groups in Enterprise Manager

Groups

Specify zero or more groups to be assigned to the user.

[Add](#)

[Remove](#)

[Select All](#) | [Select None](#)

Select	Short Name	Write	Default	Row
<input checked="" type="checkbox"/>	WR_HR	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	WR_AP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	WR_AR	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Related Topics

- [LABEL_DEFAULT: Using the Session's Default Row Label](#)
A user can update a row without specifying a label value, because the updated row uses its original label.

3.3.2 Computed Session Labels

Oracle Label Security automatically computes a number of labels based on the value of the session label.

[Table 3-2](#) lists the computed session labels.

Table 3-2 Computed Session Labels

Computed Label	Definition
Maximum Read Label	The user's maximum level combined with any combination of compartments and groups for which the user is authorized.
Maximum Write Label	The user's maximum level combined with the compartments and groups for which the user has been granted write access.
Minimum Write Label	The user's minimum level.
Default Read Label	The single default level combined with compartments and groups that have been designated as default for the user.
Default Write Label	A subset of the default read label, containing the compartments and groups to which the user has been granted write access. The level component is equal to the level default in the read label. This label is automatically derived from the read label based on the user's write authorizations.
Default Row Label	The combination of components between the user's minimum write label and the maximum write label, which has been designated as the default value for the data label for inserted data.

Related Topics

- [Computed Labels with Inverse Groups](#)
Inverse groups affect computed label values.

3.4 Evaluation of Labels for Access Mediation

Oracle Label Security evaluates labels by comparing the user's label components to the row's label components.

This way, the Oracle Label Security policy can determine whether the user can access the data. This enables Oracle Label Security to evaluate whether the user is authorized to perform the requested operation on the data in the row.

- [About Read and Write Access](#)
Although data labels are stored in a column within data records, information about user authorizations is stored in relational tables.
- [How Oracle Label Security Algorithm for Read Access Works](#)
The `READ_CONTROL` enforcement determines the ability to read data in a row.
- [How the Oracle Label Security Algorithm for Write Access Works](#)
In the context of Oracle Label Security, `WRITE_CONTROL` enforcement determines the ability to insert, update, or delete data in a row.

3.4.1 About Read and Write Access

Although data labels are stored in a column within data records, information about user authorizations is stored in relational tables.

When a user logs on, the tables are used to dynamically generate user labels for use during the session.

- [Difference Between Read and Write Operations](#)
Two fundamental types of access mediation on Data Manipulation language (DML) operations exist within protected tables: read access and write access.
- [Propagation of Read/Write Authorizations on Groups](#)
When groups are organized hierarchically, a user's assigned groups include all subgroups that are subordinate to the group to which the user belongs.

3.4.1.1 Difference Between Read and Write Operations

Two fundamental types of access mediation on Data Manipulation language (DML) operations exist within protected tables: read access and write access.

The user has a maximum authorization for the data they can read; the user's write authorization is a subset of that. The minimum write level controls the user's ability to disseminate data by lowering its sensitivity. The user cannot write data with a level lower than the minimum level the administrator assigned to this user.

In addition, there are separate lists of compartments and groups for which the user is authorized; that is, for which the user has at least read access. An access flag indicates whether the user can also write to individual compartments or groups.

3.4.1.2 Propagation of Read/Write Authorizations on Groups

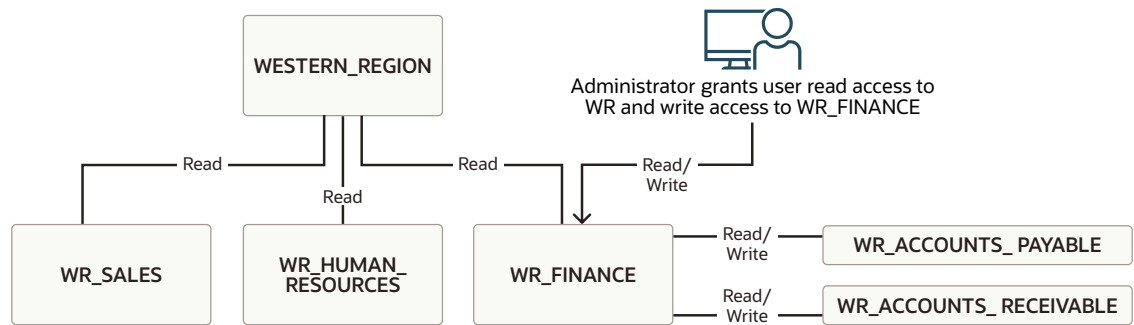
When groups are organized hierarchically, a user's assigned groups include all subgroups that are subordinate to the group to which the user belongs.

In this case, the user's read/write authorizations on a parent group flow down to all the subgroups.

Consider the parent group `WESTERN_REGION`, with three subgroups as illustrated in [Figure 3-5](#). If the user has read access to `WESTERN_REGION`, then the read access is also granted to the three subgroups. The administrator can give the user write access to subgroup `WR_FINANCE`, without granting write access to the `WESTERN_REGION` parent group (or to the other subgroups). On the other hand, if the user has read/write access on `WESTERN_REGION`, then read/write access is also granted on all of the subgroups subordinate to it in the tree.

Write authorization on a group does not give a user write authorization on the parent group. If a user has read-only access to `WESTERN_REGION` and `WR_FINANCE`, then the administrator can grant write access to `WR_ACCOUNTS_RECEIVABLE`, without affecting the read-only access to the higher-level groups.

Figure 3-5 Subgroup Inheritance of Read/Write Access



Related Topics

- [How Inverse Groups Work](#)
Inverse groups are implemented in a special way and are organized to suit the needs of Oracle Label Security.

3.4.2 How Oracle Label Security Algorithm for Read Access Works

The `READ_CONTROL` enforcement determines the ability to read data in a row.

The following rules are used, in the sequence listed, to determine a user's read access to a row of data:

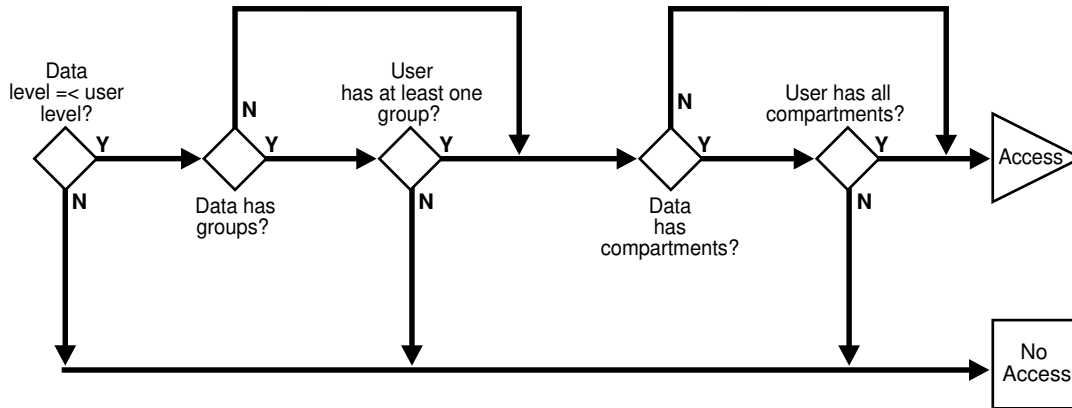
1. The user's level must be *greater than or equal to* the level of the data.
2. The user's label must include *at least one of the groups* that belong to the data (or the parent group of one such subgroup).
3. The user's label must include *all the compartments* that belong to the data.

If the user's label passes these tests, then it is said to dominate the row's label.

Note that there is no notion of read or write access connected with levels. This is because the administrator specifies a range of levels (minimum to maximum) within which a user can potentially read and write. At any time, the user can read all data equal to or less than the current session level. No privileges (other than `FULL`) allow the user to write below the minimum authorized level.

[Figure 3-6](#) illustrates how the label evaluation process proceeds from levels to groups to compartments. Note that if the data label is null or invalid, then the user is denied access.

Figure 3-6 Label Evaluation Process for Read Access



As a read access request comes in, Oracle Label Security evaluates each row to determine the following:

1. Is the user's level equal to, or greater than, the level of the data?
2. If so, does the user have access to at least one of the groups present in the data label?
3. If so, does the user have access to all the compartments present in the data label? (That is, are the data's compartments a subset of the user's compartments?)

If the answer is no at any stage in this evaluation process, then Oracle Label Security denies access to the row and moves on to evaluate the next row of data.

Oracle Label Security policies allow user sessions to read rows at their label and below, which is called *reading down*. Sessions cannot read rows at labels that they do not dominate.

For example, if you are logged in at `SENSITIVE:ALPHA,BETA`, you can read a row labeled `SENSITIVE:ALPHA` because your label dominates that of the row. However, you cannot read a row labeled `SENSITIVE:ALPHA,GAMMA` because your label does not dominate that of the row.

Note that the user can gain access to the rows otherwise denied, if they have special Oracle Label Security privileges.

Related Topics

- [Privileges Defined by Oracle Label Security Policies](#)
Oracle Label Security supports special privileges that allow authorized users to bypass certain parts of the policy.
- [Access Control Enforcement](#)
Access control options limit the rows accessible for `SELECT`, `UPDATE`, `INSERT`, or `DELETE` operations to only those rows whose labels meet established policies.

3.4.3 How the Oracle Label Security Algorithm for Write Access Works

In the context of Oracle Label Security, `WRITE_CONTROL` enforcement determines the ability to insert, update, or delete data in a row.

`WRITE_CONTROL` enables you to control data access with ever finer granularity. Granularity increases when compartments are added to levels. It increases again when groups are added to compartments. Access control becomes even more fine grained when you can manage the user's ability to write the data that they can read.

To determine whether a user can write a particular row of data, Oracle Label Security evaluates the following rules, in the order given:

1. The level in the data label must be greater than or equal to the user's minimum level and less than or equal to the user's session level.
2. When groups are present, the user's label must include *at least one of the groups with write access* that appear in the data label (or the parent of one such subgroup). In addition, the user's label must include *all the compartments* in the data label.
3. When no groups are present, the user's label must have write access on *all of the compartments* in the data label.

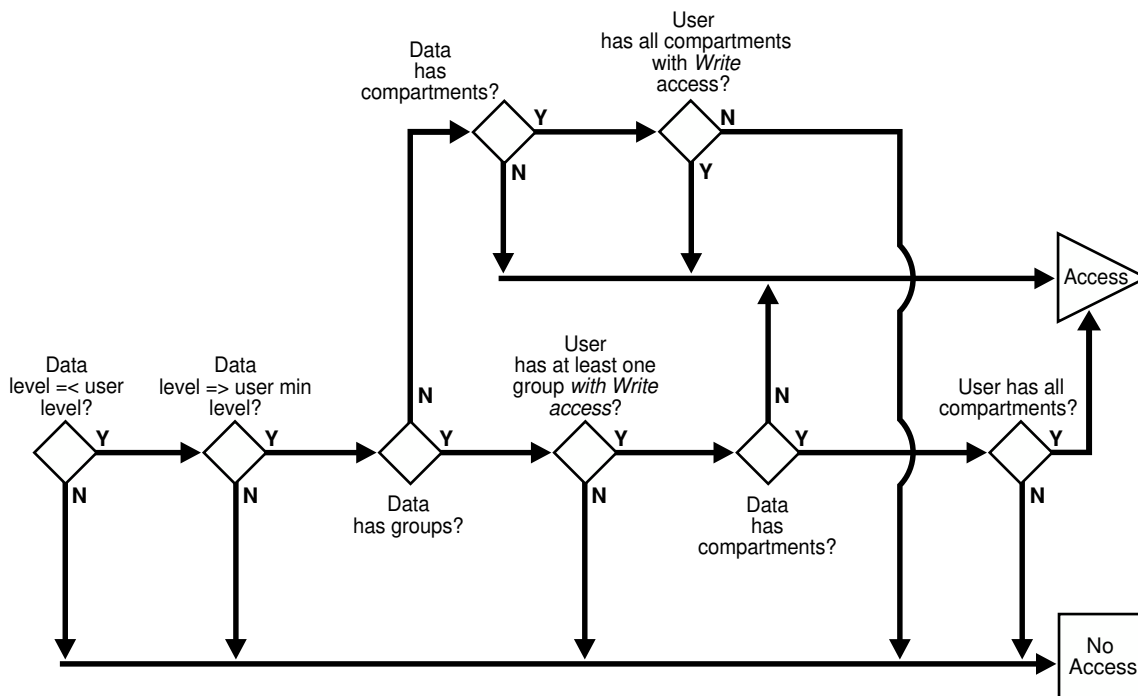
To state tests 2 and 3 another way:

- If the label has *no* groups, then the user must have write access on all the compartments in the label in order to write the data.
- If the label *does* have groups and the user has write access to one of the groups, they only need read access to the compartments in order to write the data.

Just as with read operations, the label evaluation process proceeds from levels to groups to compartments. Note that the user cannot write any data below the authorized minimum level, nor above the current session level. The user can always read below the minimum level.

Figure 3-7 illustrates how the process works with `INSERT`, `UPDATE`, and `DELETE` operations. Note that if the data label is null or invalid, then the user is denied access.

Figure 3-7 Label Evaluation Process for Write Access



As an access request comes in, Oracle Label Security evaluates each row to determine the following:

1. Is the data's level equal to, or less than the level of the user session?

2. Is the data's level equal to, or greater than the user's minimum level?
3. If the data's level falls within the foregoing bounds, then does the user have write access to at least one of the groups present in the data label?
4. If so, does the user have access to all the compartments with at least read access that are present in the data label?
5. If there are no groups but there are compartments, then does the user have write access to all of the compartments?

If the answer is no at any stage in this evaluation process, then Oracle Label Security denies access to the row, and moves on to evaluate the next row of data.

Consider a situation in which your session label is `S:ALPHA,BETA` but you have write access to only compartment `ALPHA`. In this case, you can read a row with the label `S:ALPHA,BETA` but you cannot update it.

In summary, write access is enforced on `INSERT`, `UPDATE` and `DELETE` operations upon the data in the row.

In addition, each user may have an associated minimum level below which the user cannot write. The user cannot update or delete any rows labeled with levels below the minimum, and cannot insert a row with a row label containing a level less than the minimum.

Related Topics

- [Access Control Enforcement](#)
Access control options limit the rows accessible for `SELECT`, `UPDATE`, `INSERT`, or `DELETE` operations to only those rows whose labels meet established policies.

3.5 Oracle Label Security Privileges

Oracle Label Security provides a set of system privileges, object privileges, and policy privileges.

- [Privileges Defined by Oracle Label Security Policies](#)
Oracle Label Security supports special privileges that allow authorized users to bypass certain parts of the policy.
- [Special Access Privileges](#)
A user's authorizations can be modified with any of four privileges.
- [Special Row Label Privileges](#)
Once the label on a row has been set, Oracle Label Security privileges are required to modify the label.
- [System Privileges, Object Privileges, and Policy Privileges](#)
Oracle Label Security privileges are different from the standard Oracle Database system and object privileges.
- [Access Mediation and Views](#)
Prior to accessing data through a view, the users must have the appropriate system and object privileges on the view.
- [Access Mediation and Program Unit Execution](#)
The privileges with which procedures that are owned by different users are run differently in Oracle Database and Oracle Label Security.
- [Access Mediation and Policy Enforcement Options](#)
An administrator can choose from among a set of policy enforcement options when applying an Oracle Label Security policy to individual tables.

3.5.1 Privileges Defined by Oracle Label Security Policies

Oracle Label Security supports special privileges that allow authorized users to bypass certain parts of the policy.

[Table 3-3](#) summarizes the full set of privileges that can be granted to users or trusted stored program units. Each privilege is more fully discussed after the table.

Table 3-3 Oracle Label Security Privileges

Security Privilege	Explanation
READ	Allows read access to all data protected by the policy
FULL	Allows full read and write access to all data protected by the policy
COMPACCESS	Allows a session access to data authorized by the row's compartments, independent of the row's groups
PROFILE_ACCESS	Allows a session to change its labels and privileges to those of a different user
WRITEUP	Allows users to set or raise only the level, within a row label, up to the maximum level authorized for the user. (Active only if LABEL_UPDATE is active.)
WRITEDOWN	Allows users to set or lower the level, within a row label, to any level equal to or greater than the minimum level authorized for the user. (Active only if LABEL_UPDATE is active.)
WRITEACROSS	Allows a user to set or change groups and compartments of a row label, but does not allow changes to the level. (Active only if LABEL_UPDATE is active.)

3.5.2 Special Access Privileges

A user's authorizations can be modified with any of four privileges.

- **READ Privilege**
A user with the `READ` privilege can read all data protected by the policy, regardless of the authorizations or session label.
- **FULL Privilege**
The `FULL` privilege has the same effect and benefits as the `READ` privilege and adds the `WRITE` privilege.
- **COMPACCESS Privilege**
The `COMPACCESS` privilege allows a user to access data based on the row label's compartments, independent of the row label's groups.
- **PROFILE_ACCESS Privilege**
The `PROFILE_ACCESS` privilege allows a session to change its session labels and session privileges to those of a different user.

3.5.2.1 READ Privilege

A user with the `READ` privilege can read all data protected by the policy, regardless of the authorizations or session label.

The user does not even need to have label authorizations.

Note, in addition, that a user with `READ` privilege can *write* to any data rows for which they have write access, based on any label authorizations.

**Note:**

Access mediation is still enforced on `UPDATE`, `INSERT`, and `DELETE` operations.

This privilege is useful for system administrators who need to export data but who should not be allowed to change data. It is also useful for people who must run reports and compile information but not change data. The `READ` privilege enables optimal performance on `SELECT` statements, because the system behaves as though the Oracle Label Security policy were not even present.

3.5.2.2 FULL Privilege

The `FULL` privilege has the same effect and benefits as the `READ` privilege and adds the `WRITE` privilege.

A user with the `FULL` privilege can also *write* to all the data. For a user with the `FULL` privilege, the `READ` and `WRITE` algorithms are not enforced.

Oracle system and object authorizations are still enforced for users who have been granted the `FULL` privilege. For example, a user must still have the `SELECT` system privilege on the application table. The `FULL` authorization turns off the access mediation check at the individual row level.

3.5.2.3 COMPACCESS Privilege

The `COMPACCESS` privilege allows a user to access data based on the row label's compartments, independent of the row label's groups.

If a row label has no compartments, then access is determined by the group authorizations. However, when compartments do exist and access to them is authorized, then the group authorization is bypassed. This allows a privileged user whose label matches all the compartments of the data to access any data in any particular compartment, independent of what groups may own or otherwise be allowed access to the data.

[Figure 3-8](#) shows the label evaluation process for read access with the `COMPACCESS` privilege. Note that if the data label is null or invalid, then the user is denied access.

Figure 3-8 Label Evaluation Process for Read Access with COMPACCESS Privilege

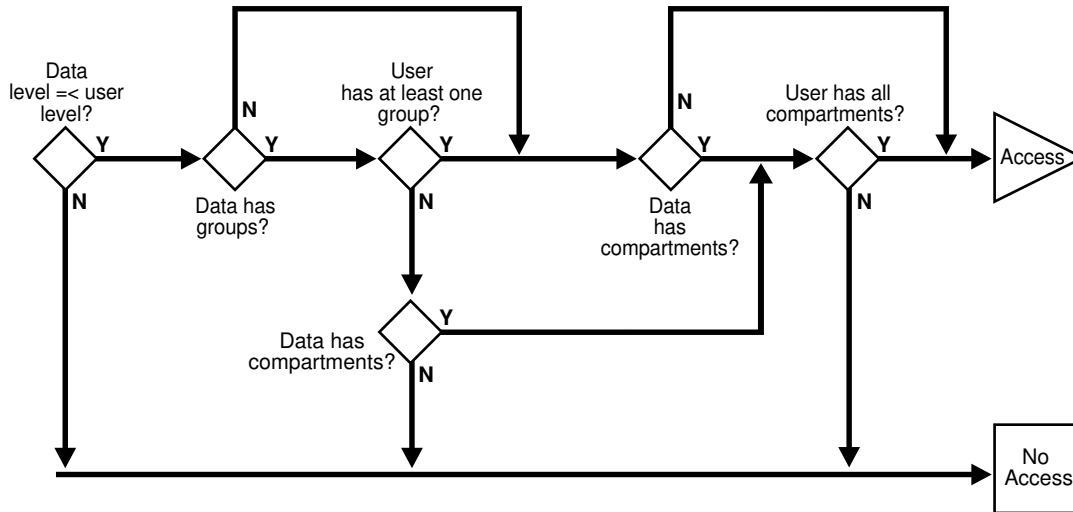
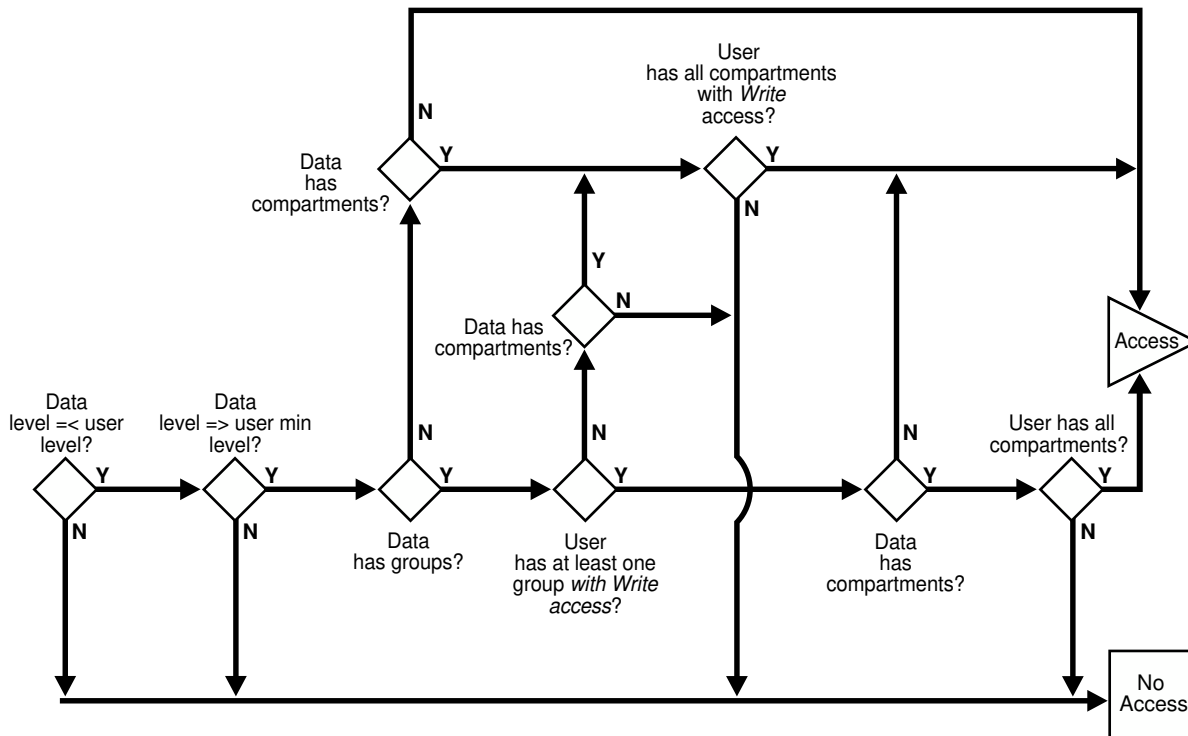


Figure 3-9 shows the label evaluation process for write access with COMPACCESS privilege. Note that if the data label is null or invalid, then the user is denied access.

Figure 3-9 Label Evaluation Process for Write Access with COMPACCESS Privilege



3.5.2.4 PROFILE_ACCESS Privilege

The PROFILE_ACCESS privilege allows a session to change its session labels and session privileges to those of a different user.

This is a very powerful privilege, because the user can potentially become a user with the `FULL` privilege. This privilege cannot be granted to a trusted stored program unit.

3.5.3 Special Row Label Privileges

Once the label on a row has been set, Oracle Label Security privileges are required to modify the label.

Note that the `LABEL_UPDATE` enforcement option must be on for these label modification privileges to be enforced. When a user updates a row label, the new label and old label are compared, and the required privileges are determined.

The special row label privileges include:

- **WRITEUP Privilege**
The `WRITEUP` privilege enables the user to raise the level of data within a row, without compromising the compartments or groups.
- **WRITEDOWN Privilege**
The `WRITEDOWN` privilege enables the user to lower the level of data within a row, without compromising the compartments or groups.
- **WRITEACROSS Privilege**
The `WRITEACROSS` privilege allows the user to change the compartments and groups of data, without altering its sensitivity level.

3.5.3.1 WRITEUP Privilege

The `WRITEUP` privilege enables the user to raise the level of data within a row, without compromising the compartments or groups.

This privilege enables a user to raise the level up to their maximum authorized level. You can find the privileges that users have by querying the `ALL_SA_USER_PRIVS` data dictionary view.

For example, an authorized user can raise the level of a data row that has a level lower than their own minimum level. If a row is `UNCLASSIFIED` and the user's maximum level is `SENSITIVE`, then the row's level can be raised to `SENSITIVE`. It can be raised above the current session level, but it cannot change the compartments.

3.5.3.2 WRITEDOWN Privilege

The `WRITEDOWN` privilege enables the user to lower the level of data within a row, without compromising the compartments or groups.

The user can lower the level to any level equal to or greater than their minimum authorized level. You can find the privileges that have been granted to a user by querying the `ALL_SA_USER_PRIVS` data dictionary view.

3.5.3.3 WRITEACROSS Privilege

The `WRITEACROSS` privilege allows the user to change the compartments and groups of data, without altering its sensitivity level.

This guarantees, for example, that `SENSITIVE` data remains at the `SENSITIVE` level, but at the same time enables the data's dissemination to be managed.

It lets the user change compartments and groups to anything that is currently defined as a valid compartment or group within the policy, while maintaining the level. With the `WRITEACROSS`

privilege, a user with read access to one group (or more) can write to a different group without explicitly being given access to it.

You can find the privileges that have been granted to a user by querying the `ALL_SA_USER_PRIVS` data dictionary view.

3.5.4 System Privileges, Object Privileges, and Policy Privileges

Oracle Label Security privileges are different from the standard Oracle Database system and object privileges.

Table 3-4 Types of Privilege

Source	Privileges	Definition
Oracle Database	System Privileges	The right to run a particular type of SQL statement
Oracle Database	Object Privileges	The right to access another user's object
Oracle Label Security	Policy Privileges	The ability to bypass certain parts of the label security policy

Oracle Database enforces the discretionary access control privileges that a user has been granted. By default, a user has no privileges except those granted to the `PUBLIC` user group. A user must explicitly be granted the appropriate privilege to perform an operation.

For example, to read an object in Oracle Database, you must either be the object's owner, or be granted the `SELECT` privilege on the object, or be granted the `SELECT ANY TABLE` system or schema privilege. Similarly, to update an object, you must either be the object's owner, or be granted the `UPDATE` privilege on the object, or be granted the `UPDATE ANY TABLE` privilege.

Related Topics

- [Oracle Database Security Guide](#)

3.5.5 Access Mediation and Views

Prior to accessing data through a view, the users must have the appropriate system and object privileges on the view.

If the underlying table (on which the view is based) is protected by Oracle Label Security, then the user of the view must have authorization from Oracle Label Security to access specific rows of labeled data.

3.5.6 Access Mediation and Program Unit Execution

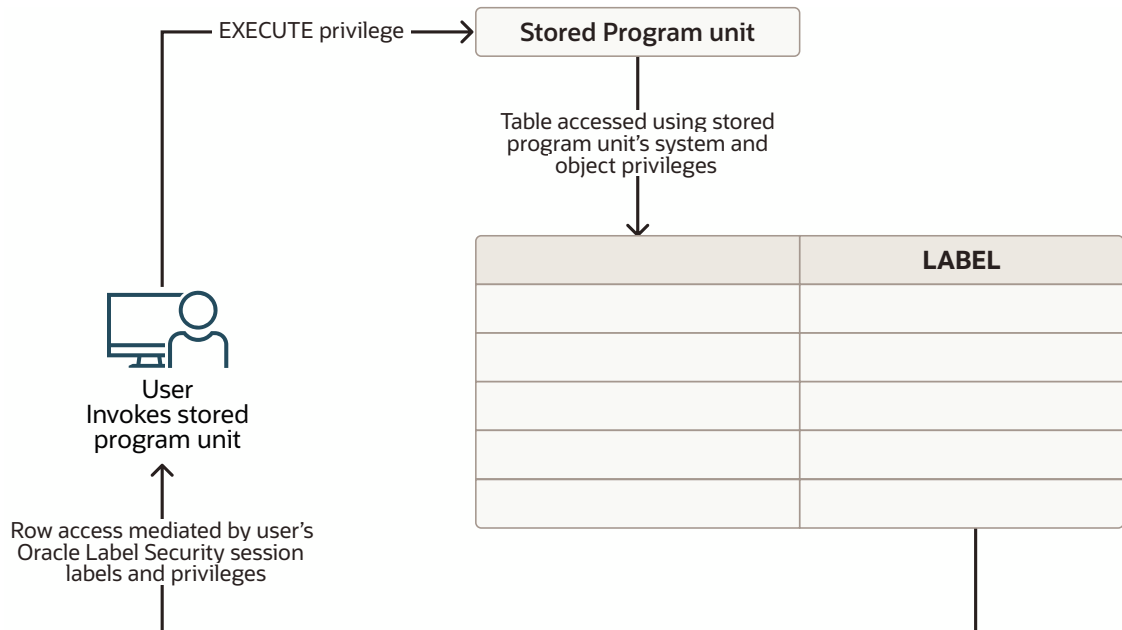
The privileges with which procedures that are owned by different users are run differently in Oracle Database and Oracle Label Security.

For example, in Oracle Database, if `user1` runs a procedure that belongs to `user2`, then the procedure runs with `user2`'s system and object privileges. You can find the privileges that have been granted to a user by querying the `DBA_SYS_PRIVS` data dictionary view. However, any procedure run by `user1` runs with `user1`'s own Oracle Label Security labels and privileges. This is true even when `user1` runs stored program units owned by other users.

[Figure 3-10](#) illustrates this process:

- Stored program units run with the DAC privileges of the procedure's owner (`user2`).
- In addition, stored program units accessing tables protected by Oracle Label Security mediate access to data rows based on the label attached to the row, and the Oracle Label Security labels and privileges of the invoker of the procedure (`user1`).

Figure 3-10 Stored Program Unit Execution



Stored program units can become *trusted* when an administrator assigns them Oracle Label Security privileges. A stored program unit can be run with its own autonomous Oracle Label Security privileges rather than those of the user who calls it. For example, if you possess no Oracle Label Security privileges in your own right but run a stored program unit that has the `WRITEDOWN` privilege, then you can update labels. In this case, the privileges used are those of the stored program unit, and not your own.

Trusted program units can encapsulate privileged operations in a controlled manner. By using procedures, packages, and functions with assigned privileges, you may be able to access data that your own labels and privileges would not authorize. For example, to perform aggregate functions over all data in a table, not just the data visible to you, you might use a trusted program set up by an administrator. This way program units can thus perform operations on behalf of users, without the need to grant privileges directly to users.

Related Topics

- [Administering and Using Trusted Stored Program Units](#)
You can use trusted stored program units to enhance system security.

3.5.7 Access Mediation and Policy Enforcement Options

An administrator can choose from among a set of policy enforcement options when applying an Oracle Label Security policy to individual tables.

These options enable enforcement to be tailored differently for each database table. In addition to the access controls based on the labels, a SQL predicate can also be associated with each table. The predicate can further define which rows in the table are accessible to the user.

In cases where the label to be associated with a new or updated row should be automatically computed, an administrator can specify a labeling function when applying the policy. That function will thereafter always be invoked to provide the data labels written under that policy, because active labeling functions take precedence over any alternative means of supplying a label.

Except where noted, this guide assumes that all enforcement options are in effect.

Related Topics

- [Implementing Policy Enforcement Options and Labeling Functions](#)
You can customize the enforcement of Oracle Label Security policies and implement labeling functions.
- [Labeling Functions](#)
Labeling functions can compute and return a label using resources such as context variables (for example, date or username) and data values.
- [SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to all of the tables in a schema and enables the policy for these tables.

3.6 Working with Multiple Oracle Label Security Policies

You can use multiple Oracle Label Security policies in both a single database environments and in a distributed environments.

- [Multiple Oracle Label Security Policies in a Single Database](#)
Several Oracle Label Security policies can protect data in a single database.
- [Multiple Oracle Label Security Policies in a Distributed Environment](#)
In a distributed environment that uses Oracle Label Security, remote connections are controlled by Oracle Label Security.

3.6.1 Multiple Oracle Label Security Policies in a Single Database

Several Oracle Label Security policies can protect data in a single database.

Each defined policy is associated with a set of labels used only by that policy. Data labels are constrained by the set of defined labels for each policy.

Each policy may protect a different table, but multiple policies can also apply to a single table. To access data, you must have label authorizations for all policies protecting that data. To access any particular row, you must be authorized by *all* policies protecting the table containing your desired rows. If you require privileges, then you may need privileges for all of the policies affecting your work.

For performance reasons, restrict the number of policies and the number of tables to which OLS policies are applied. In most cases, only the central table needs to be protected—not every child table associated with the main table.

3.6.2 Multiple Oracle Label Security Policies in a Distributed Environment

In a distributed environment that uses Oracle Label Security, remote connections are controlled by Oracle Label Security.

Related Topics

- [Using Oracle Label Security with a Distributed Database](#)
You should understand the special considerations for using Oracle Label Security in a distributed configuration.

Part II

Using Oracle Label Security Functionality

Part II explains how to work with Oracle Label Security functionality.

- [Registering and Logging in to Oracle Label Security](#)
Before using Oracle Label Security, you must register (configure) it with the database and then you can log in to Oracle Label Security.
- [Creating an Oracle Label Security Policy](#)
An Oracle Label Security policy is a named set of commands that implements Oracle Label Security.
- [Working with Labeled Data](#)
You can manage labeled data, view session security attributes, and change the value of session attributes.

4

Registering and Logging in to Oracle Label Security

Before using Oracle Label Security, you must register (configure) it with the database and then you can log in to Oracle Label Security.

- [Registering Oracle Label Security with an Oracle Database](#)
You must register Oracle Label Security with the database in which you plan to use it.
- [Security Guideline for Managing the Oracle Label Security Administrative User](#)
You must create a special administrative user who will be responsible for managing Oracle Label Security.
- [Managing Oracle Label Security from Enterprise Manager Cloud Control](#)
From Enterprise Manager Cloud Control, you use the Oracle Label Security pages to create and manage Oracle Label Security policies.
- [Managing Oracle Label Security from SQL*Plus](#)
You can manage Oracle Label Security from SQL*Plus if you have been granted the `LBAC_DBA` database role.

4.1 Registering Oracle Label Security with an Oracle Database

You must register Oracle Label Security with the database in which you plan to use it.

- [About Registering Oracle Label Security](#)
When you install Oracle Database, Oracle Label Security is included in the installation but by default it is not enabled.
- [Checking if Oracle Label Security Has Been Registered and Enabled](#)
You can query the `DBA_OLS_STATUS` data dictionary view to find if Oracle Label Security has already been registered and enabled.
- [Registering and Enabling Oracle Label Security from SQL*Plus](#)
You can both register and enable Oracle Label Security from SQL*Plus.
- [Registering and Enabling Oracle Label Security Using DBCA](#)
You can both register and enable Oracle Label Security using Database Configuration Assistant.
- [Recompiling Oracle Label Security](#)
If invalid objects appear in Oracle Label Security after you have upgraded, then you must recompile Oracle Label Security to remove these invalid objects.

4.1.1 About Registering Oracle Label Security

When you install Oracle Database, Oracle Label Security is included in the installation but by default it is not enabled.

This applies if you install Oracle Database by using the typical installation method in Database Configuration Assistant (DBCA). If you install using a custom installation, then you can

optionally register Oracle Label Security from DBCA as part of the Oracle Database installation process.

If you installed using the typical installation method, then you must manually register (enable) Oracle Label Security before you can use it. You have the choice of using either SQL*Plus or DBCA to perform the registration.

After Oracle Label Security is registered, you must you must create an Oracle Label Security administrative user and grant it the `LBAC_DBA` role and `EXECUTE` privileges on the Oracle Label Security management packages. Afterward, you can disable and re-enable Oracle Label Security when necessary.

Only register Oracle Label Security in the pluggable databases (PDBs) in which you plan to create Oracle Label Security policies. Because Oracle Label Security is not designed to protect data dictionary objects, you cannot create policies in the root.

4.1.2 Checking if Oracle Label Security Has Been Registered and Enabled

You can query the `DBA_OLS_STATUS` data dictionary view to find if Oracle Label Security has already been registered and enabled.

1. Log into the appropriate PDB as user `SYS` with the `SYSDBA` administrative privilege.

```
sqlplus sys@pdb_name as sysdba
Enter password: password
```

To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.

2. Run the following query:

```
SELECT * FROM DBA_OLS_STATUS;
```

NAME	STATUS	DESCRIPTION
OLS_CONFIGURE_STATUS	TRUE	Determines if OLS is configured
OLS_ENABLE_STATUS	TRUE	Determines if OLS is enabled

4.1.3 Registering and Enabling Oracle Label Security from SQL*Plus

You can both register and enable Oracle Label Security from SQL*Plus.

1. Log into the appropriate PDB as user `SYS` with the `SYSDBA` administrative privilege.

```
sqlplus sys@pdb_name as sysdba
Enter password: password
```

To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.

2. Register and enable Oracle Label Security as follows.

```
EXEC LBACSYS.CONFIGURE_OLS; -- This procedure registers Oracle Label Security.
EXEC LBACSYS.OLS_ENFORCEMENT.ENABLE_OLS; -- This procedure enables it.
```

After you invoke `LBACSYS.CONFIGURE_OLS`, all pending transactions are committed and cannot be rolled back, in the event that `LBACSYS.CONFIGURE_OLS` fails.

`LBACSYS.CONFIGURE_OLS` can fail for reasons such as a pre-existing `LBAC_TRIGGER` schema.

3. Close and reopen the PDB.

For example:

```
ALTER PLUGGABLE DATABASE pdb_name CLOSE IMMEDIATE;  
ALTER PLUGGABLE DATABASE pdb_name OPEN;
```

4.1.4 Registering and Enabling Oracle Label Security Using DBCA

You can both register and enable Oracle Label Security using Database Configuration Assistant.

1. Start Database Configuration Assistant (DBCA).
 - **UNIX:** Run the following command:

```
$ORACLE_HOME/bin/dbca
```
 - **Windows:** From the **Start** menu, click **All Programs**. Then click **Oracle - ORACLE_HOME**, then **Configuration and Migration Tools**, and then **Database Configuration Assistant**.
The Welcome screen appears.
2. Click **Next**.
The Operations screen appears.
3. Select **Configure Database Options**. Click **Next**.
The Database screen appears.
4. From the list, select the database where you need to configure and enable OLS. Click **Next**.
The Database Content screen appears.
5. Select **Oracle Label Security**. Click **Next**.
The Connection Mode screen appears.
6. Select either **Dedicated Server Mode** or **Shared Server Mode**. Click **Finish**.
A dialog box is displayed informing you that the operation will require the database to be restarted.
7. Click **OK**.
A confirmation dialog box is displayed.
8. Click **OK**.
The DBCA progress screen is displayed.
9. After the operation is complete, you are prompted to perform another operation. Click **No** to exit DBCA.

4.1.5 Recompiling Oracle Label Security

If invalid objects appear in Oracle Label Security after you have upgraded, then you must recompile Oracle Label Security to remove these invalid objects.

Errors such as the following indicate that there are invalid objects: failures with the `catuppst.sql` script, CATCL errors, ORA-06550: identifier must be declared errors, or ORA-942 (OLS Is Invalid) errors.

1. Disable and then enable Oracle Label Security.

2. Recompile the objects within LBACSYS.

```
EXEC DBMS_UTILITY.COMPILE_SCHEMA(SCHEMA => 'LBACSYS');
```

3. If dependent database objects require re-compilation as well, then recompile all the database objects, as follows:

```
@$ORACLE_HOME/rdbms/admin/utlpr.sql
```

4. In the appropriate PDB, use SQL*Plus, to validate Oracle Label Security.

```
EXECUTE SYS.VALIDATE_OLS;
```

5. If the utlpr.sql script compiles all the OLS (LDAPSYS) objects successfully, and there are no errors during compilation, then run the following command to list information about Oracle Label Security components that are loaded into the component registry:

```
EXECUTE DBMS_REGISTRY.VALID('OLS');
```

Related Topics

- [Disabling and Enabling Oracle Label Security](#)
You can disable and enable Oracle Label Security as necessary.

4.2 Security Guideline for Managing the Oracle Label Security Administrative User

You must create a special administrative user who will be responsible for managing Oracle Label Security.

In previous releases, Oracle Label Security provided a special user, LBACSYS, for users who were responsible for managing Oracle Label Security. An Oracle Label Security administrator must not use LBACSYS, because this term has been a dictionary protected user since release 21c. Therefore, you must have a named user designated as an Oracle Label Security administrator. The LBAC_DBA role itself does not have all the necessary privileges.

To create an Oracle Label Security administrative user, create a user who has the appropriate privileges. For example:

```
CREATE USER "SA_DEMO" IDENTIFIED BY "SA_DEMO";
GRANT CONNECT, RESOURCE, UNLIMITED TABLESPACE, SELECT_CATALOG_ROLE TO SA_DEMO;
GRANT EXECUTE ON SA_COMPONENTS TO SA_DEMO WITH GRANT OPTION;
GRANT EXECUTE ON SA_USER_ADMIN TO SA_DEMO WITH GRANT OPTION;
GRANT EXECUTE ON SA_USER_ADMIN TO SA_DEMO WITH GRANT OPTION;
GRANT EXECUTE ON SA_LABEL_ADMIN TO SA_DEMO WITH GRANT OPTION;
GRANT EXECUTE ON SA_POLICY_ADMIN TO SA_DEMO WITH GRANT OPTION;
GRANT EXECUTE ON SA_AUDIT_ADMIN TO SA_DEMO WITH GRANT OPTION;
GRANT EXECUTE ON SA_SYSDBA TO SA_DEMO;
GRANT EXECUTE ON TO_LBAC_DATA_LABEL TO SA_DEMO;
GRANT LBAC_DBA TO SA_DEMO;
```

When users create Oracle Label Security policies, Oracle Label Security creates and grants to the user a special role for the policy named in the format of *policy_DBA*. Only a user who has

this role and the `EXECUTE` privilege on the `SA_POLICY_ADMIN` package can manage the policy. The `LBAC_DBA` role does not provide privileges to manage the policy.

4.3 Managing Oracle Label Security from Enterprise Manager Cloud Control

From Enterprise Manager Cloud Control, you use the Oracle Label Security pages to create and manage Oracle Label Security policies.

1. Ensure that you have configured the Cloud Control target databases that you plan to use with Oracle Label Security.

See the Oracle Enterprise Manager online help for more information about configuring target databases.

2. Point your browser to the Cloud Control login page.

For example:

```
https://myserver.example.com:7799/em
```

3. Log into Cloud Control as user `SYSMAN`.
4. In the Cloud Control home page, from the **Targets** menu, select **Databases**.
5. In the Databases page, select the link for the database to which you want to connect.

The Database home page appears.

6. From the **Security** menu, select **Label Security**.

The Database Login page appears.

7. Enter the following information:

- **Username:** Enter the Oracle Label Security administrator user name.
- **Password:** Enter the password.
- **Role:** Select **NORMAL** from the list.
- **Save As:** Select this check box if you want these credentials to be automatically filled in for you the next time that this page appears. The credentials are stored in Enterprise Manager in a secured manner. Access to these credentials depends on the user who is currently logged in.

4.4 Managing Oracle Label Security from SQL*Plus

You can manage Oracle Label Security from SQL*Plus if you have been granted the `LBAC_DBA` database role.

- To use Oracle Label Security from SQL*Plus, connect as the Oracle Label Security administrator user.

For example:

```
sqlplus name_ols_admin@pdb_name  
Enter password: password
```

To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.

5

Creating an Oracle Label Security Policy

An Oracle Label Security policy is a named set of commands that implements Oracle Label Security.

- [About Creating Oracle Label Security Policies](#)
An Oracle Label Security policy enforces user access to data based on labels.
- [Privileges for Managing Oracle Label Security Policies](#)
When a user creates an Oracle Label Security policy container, Oracle Label Security creates and grants this user an administrative role that is specific to the policy, named in the format of *policy_DBA*.
- [Step 1: Create the Label Security Policy Container](#)
The Oracle Label Security policy container is a storage place for the policy settings.
- [Step 2: Create Labels for the Label Security Policy](#)
After you create a policy container, you are ready to create data labels to be used by each row in the protected table(s)..
- [Step 3: Authorize Users for the Label Security Policy](#)
Before users can have access to data that is protected by an Oracle Label Security policy, they must be authorized.
- [Step 4: Grant Privileges to Users and Trusted Stored Program Units](#)
Oracle Label Security supports special privileges that allow authorized users to bypass certain parts of the policy
- [Step 5: Apply the Policy to a Database Table or Schema](#)
After you create grant authorizations and privileges to an Oracle Label Security policy, you can apply it to a database table or schema.
- [Step 6: Add Policy Data Labels to Table Rows](#)
You must add policy data labels to table rows.
- [Step 7: Optionally, Configure Auditing](#)
For Oracle Label Security policies, if you want to enable auditing, then you must create a unified audit policy.
- [Using Oracle Label Security Policies and Oracle Flashback Data Archive](#)
Oracle Label Security policies do not automatically work with Oracle Flashback Data Archive (FDA).
- [Using Enterprise Manager Cloud Control to Create an OLS Policy](#)
You can create Oracle Label Security policies in Oracle Enterprise Manager Cloud Control. However, you cannot create audit policies using Cloud Control; you must use SQL*Plus to create unified audit policies.

5.1 About Creating Oracle Label Security Policies

An Oracle Label Security policy enforces user access to data based on labels.

1. Create a policy container that defines the policy name, the name of a column that Oracle Label Security will add to the tables to be protected, whether to hide this column, whether to enable the policy, and default enforcement options for the policy.

See [Step 1: Create the Label Security Policy Container](#) for more information.

2. Define the following components for the label: level of sensitivity, and optionally, compartments and groups to further filter the label sensitivity. Once you have the components defined, create the label itself and then associate these components with the label.

See [Step 2: Create Labels for the Label Security Policy](#).

3. Authorize users for the policy.

See [Step 3: Authorize Users for the Label Security Policy](#) for more information.

4. Grant privileges to these users or to trusted program units.

See [Step 4: Grant Privileges to Users and Trusted Stored Program Units](#) for more information.

5. Apply the policy to a database table. Alternatively, you can apply the policy to an entire schema.

See [Step 5: Apply the Policy to a Database Table or Schema](#) for more information.

6. Add the policy labels to the table rows. You must update the table that is being used for the policy.

See [Step 6: Add Policy Data Labels to Table Rows](#) for more information.

7. Optionally, configure audit settings for users.

See [Step 7: Optionally, Configure Auditing](#) for more information.

5.2 Privileges for Managing Oracle Label Security Policies

When a user creates an Oracle Label Security policy container, Oracle Label Security creates and grants this user an administrative role that is specific to the policy, named in the format of *policy_DBA*.

For example, for a policy named `emp_ols_pol`, the role name is `EMP_OLS_POL_DBA`. This role becomes effective only after a new user session begins.

To enable the user to manage the policy, Oracle Label Security performs these checks in the following order:

1. Checks if the user is granted the *policy_DBA* role.
2. Checks if the *policy_DBA* is enabled for this user.
3. In the event of a nested call stack, checks if the top definer's rights procedure owner has been granted the *policy_DBA* role.
4. Checks if the *policy_DBA* role is granted to the `LBACSYS` user, which is the current user.

5.3 Step 1: Create the Label Security Policy Container

The Oracle Label Security policy container is a storage place for the policy settings.

- [About the Label Security Policy Container](#)

The Oracle Label Security policy container stores metadata that describes how the policy behaves.

- [Creating a Label Policy Container](#)
You can use the `SA_SYSDBA.CREATE_POLICY` procedure to create an Oracle Label Security policy container.

5.3.1 About the Label Security Policy Container

The Oracle Label Security policy container stores metadata that describes how the policy behaves.

This container defines the policy name, the name of a column that Oracle Label Security will add to the tables to be protected, whether to hide this column, and default enforcement options for the policy.

The column that you add to the tables that you want to protect will include data labels (which you create later on) that are assigned to specific rows in a the table, based on values in a specific column or other attributes.

You can create the policy container in Oracle Enterprise Manager Cloud Control, or use the `SA_SYSDBA.CREATE_POLICY` procedure.

5.3.2 Creating a Label Policy Container

You can use the `SA_SYSDBA.CREATE_POLICY` procedure to create an Oracle Label Security policy container.

- To create the policy, run `SA_SYSDBA.CREATE_POLICY`, specifying the policy name, column name, and default options.

For example:

```
BEGIN
  SA_SYSDBA.CREATE_POLICY (
    policy_name      => 'emp_ols_pol',
    column_name      => 'ols_col',
    default_options  => 'read_control, update_control');
END;
/
```

Related Topics

- [SA_SYSDBA.CREATE_POLICY](#)
The `SA_SYSDBA.CREATE_POLICY` procedure creates a new Oracle Label Security policy, defines a policy-specific column name, and specifies default policy options.

5.4 Step 2: Create Labels for the Label Security Policy

After you create a policy container, you are ready to create data labels to be used by each row in the protected table(s)..

- [About Labels](#)
A label indicates the sensitivity associated with a data record or user.
- [About Policy Level Sensitivity Components](#)
A *level* is a ranking that denotes the sensitivity of the information it labels.
- [Creating a Policy Level Component](#)
The `SA_COMPONENTS.CREATE_LEVEL` procedure creates a policy level component.

- [About Policy Compartment Components](#)
Compartments identify areas that describe the sensitivity of the labeled data, providing a finer level of granularity within a level.
- [Creating a Policy Compartment Component](#)
The `SA_COMPONENTS.CREATE_COMPARTMENT` procedure creates an Oracle Label Security compartment.
- [About Policy Group Components](#)
Groups can identify organizations, regions, or other organizing structures that are allowed to access the data, such as `EASTERN_REGION`, `WESTERN_REGION`, `WR_SALES`.
- [Creating a Policy Label Group](#)
The `SA_COMPONENTS.CREATE_GROUP` procedure creates a label group.
- [About Associating the Policy Components with a Named Data Label](#)
After defining the label components, you can create a data label itself by associating it with an existing policy.
- [Associating the Policy Components with a Named Data Label](#)
The `SA_LABEL_ADMIN.CREATE_LABEL` procedure creates a data label.

5.4.1 About Labels

A label indicates the sensitivity associated with a data record or user.

Each label is a single attribute with multiple components that control the types of filtering to be used for user access.

[Table 5-1](#) describes the different components of a label.

Table 5-1 Label Components

Component	Description	Examples
Level	Required - at least one level must be defined An ordered rank of names indicating sensitivity.	CONFIDENTIAL (1), SENSITIVE (2), HIGHLY_SENSITIVE (3)
Compartments	Used to provide a finer level of granularity to the sensitivity level and can represent projects or other sensitive topics. Zero or more compartments can be associated with a label.	FINANCIAL, STRATEGIC, NUCLEAR
Groups	Represent organizations, regions, or other attributes. Zero or more groups can be associated with a label.	EASTERN_REGION, WESTERN_REGION

All labels must contain a level component, but the compartment and group components are optional. Compartments and groups are a way of fine tuning access that users will have to the data. Valid characters for specifying all label components include alphanumeric characters, underscores, and spaces. (Leading and trailing spaces are ignored.) You must define the label components before you can create data labels.

You can use Enterprise Manager Cloud Control to create the label and its components for an existing policy. Alternatively, you can use the `SA_COMPONENTS` PL/SQL package to create the components, and the `SA_LABEL_ADMIN` package to create the data label.

Related Topics

- [SA_COMPONENTS Label Components PL/SQL Package](#)
The SA_COMPONENTS PL/SQL package manages the component definitions of an Oracle Label Security label.

5.4.2 About Policy Level Sensitivity Components

A *level* is a ranking that denotes the sensitivity of the information it labels.

The more sensitive the information, the higher its level. The less sensitive the information, the lower its level.

Every label must include one level. Oracle Label Security permits up to 10,000 levels in a policy. For each level, you must define a numeric form, a long character form, and the required short character form.

[Table 5-2](#) shows examples of levels.

Table 5-2 Policy Level Example

Numeric Form	Long Form	Short Form
40	HIGHLY_SENSITIVE	HS
30	SENSITIVE	S
20	CONFIDENTIAL	C
10	PUBLIC	P

[Table 5-2](#) explains the numeric form, long form, and short form for levels.

Table 5-3 Forms of Specifying Levels

Form	Explanation
Numeric form, also called "tag"	The numeric form of the level can range from 0 to 9999. Sensitivity is ranked by this numeric value, so you must assign higher numbers to levels that are more sensitive, and lower numbers to levels that are less sensitive. In Table 5-2 , 40 (HIGHLY_SENSITIVE) is a higher level than 30, 20, and 10. Administrators should avoid using sequential numbers for the numeric form of levels. A good strategy is to space out the numbers between levels (such as 10, 20, 30... or 100, 200, 300...). You can then insert additional levels between two preexisting levels, at a later date.
Long form	The long form of the level name can contain up to 80 characters.
Short form	The short form can contain up to 30 characters.

Although you define both long and short names for the level (and for each of the other label components), only the short form of the name is displayed upon retrieval. When users manipulate the labels, they use only the short form of the component names.

Examples of levels can be names such as TOP_SECRET, SECRET, CONFIDENTIAL, and UNCLASSIFIED or TRADE_SECRET, PROPRIETARY, COMPANY_CONFIDENTIAL, PUBLIC_DOMAIN.

If you use only levels, a level 40 user (in this example) can access or alter any data row whose level is 40 or less.

5.4.3 Creating a Policy Level Component

The `SA_COMPONENTS.CREATE_LEVEL` procedure creates a policy level component.

- To create the policy level component, run `SA_COMPONENTS.CREATE_LEVEL`, specifying the policy name and details about the component.

For example:

```
BEGIN
  SA_COMPONENTS.CREATE_LEVEL (
    policy_name => 'emp_ols_pol',
    level_num   => 40,
    short_name  => 'HS',
    long_name   => 'HIGHLY_SENSITIVE');
END;
/
```

Related Topics

- [SA_COMPONENTS.CREATE_LEVEL](#)
The `SA_COMPONENTS.CREATE_LEVEL` procedure creates a level and specify its short name and long name.

5.4.4 About Policy Compartment Components

Compartments identify areas that describe the sensitivity of the labeled data, providing a finer level of granularity within a level.

All data related to a particular project can be labeled with the same compartment. For example, a user with level `HS` that has access to compartments `FINCL` and `CHEM` would not be allowed access to any data that includes the `OP` compartment.

[Table 5-4](#) shows an example set of compartments.

Table 5-4 Policy Compartment Example

Numeric Form	Long Form	Short Form
85	FINANCIAL	FINCL
65	CHEMICAL	CHEM
45	OPERATIONAL	OP

[Table 5-5](#) shows different ways to specify compartments.

Table 5-5 Forms of Specifying Compartments

Form	Explanation
Numeric form	<p>The numeric form can range from 0 to 9999. It is unrelated to the numbers used for the levels. The numeric form of the compartment does not indicate greater or less sensitivity. Instead, it controls the display order of the short form compartment name in the label character string. For example, assume a label is created that has all three compartments listed in Table 5-4, and a level of SENSITIVE. When this label is displayed in string format, it looks like this:</p> <pre>S:OP,CHEM,FINCL</pre> <p>meaning SENSITIVE: OPERATIONAL, CHEMICAL, FINANCIAL</p> <p>The display order follows the order of the numbers assigned to the compartments: 45 is lower than 65, and 65 is lower than 85. By contrast, if the number assigned to the FINCL compartment were 5, the character string format of the label would look like this:</p> <pre>S:FINCL,OP,CHEM</pre>
Long form	The long form of the compartment name can have up to 80 characters.
Short form	The short form can contain up to 30 characters.

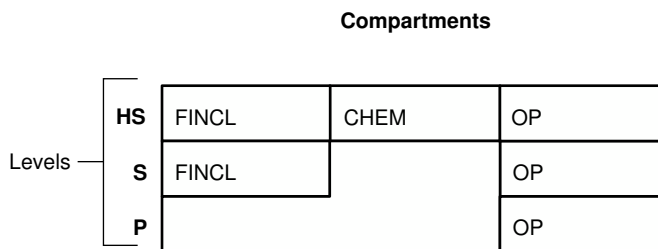
Compartments are optional. You can include up to 10,000 compartments for a label.

Not all labels must have compartments. For example, you can specify HIGHLY_SENSITIVE and CONFIDENTIAL levels with no compartments, and a SENSITIVE level that does contain compartments.

When you analyze the sensitivity of data, you may find that some compartments are only useful at specific levels.

The following figure shows how compartments can be used to categorize data.

Figure 5-1 Compartments in a Label



Here, compartments FINCL, CHEM, and OP are used with the level HIGHLY_SENSITIVE (HS). The label HIGHLY_SENSITIVE:FINCL, CHEM indicates a level of 40 with the two named compartments. Compartment FINCL is not more sensitive than CHEM, nor is CHEM more sensitive than FINCL. Note also that some data in the protected table may not belong to any compartment.

If you specify compartments, then a user whose level would normally permit access to a row's data will nevertheless be prevented from such access unless the user's label also contains all the compartments appearing in that row's label. For example, user hpreston, who is granted access to the HS level, could be granted access only to FINCL and CHEM but not to OP.

5.4.5 Creating a Policy Compartment Component

The `SA_COMPONENTS.CREATE_COMPARTMENT` procedure creates an Oracle Label Security compartment.

- To create the compartment, run the `SA_COMPONENTS.CREATE_COMPARTMENT` procedure to create a compartment, specifying the policy name and details about the compartment.

```
BEGIN
  SA_COMPONENTS.CREATE_COMPARTMENT (
    policy_name => 'emp_ols_pol',
    comp_num   => '85',
    short_name  => 'FINCL',
    long_name   => 'FINANCIAL');
END;
/
```

Related Topics

- [SA_COMPONENTS.CREATE_COMPARTMENT](#)
The `SA_COMPONENTS.CREATE_COMPARTMENT` procedure creates a compartment and specify its short name and long name.

5.4.6 About Policy Group Components

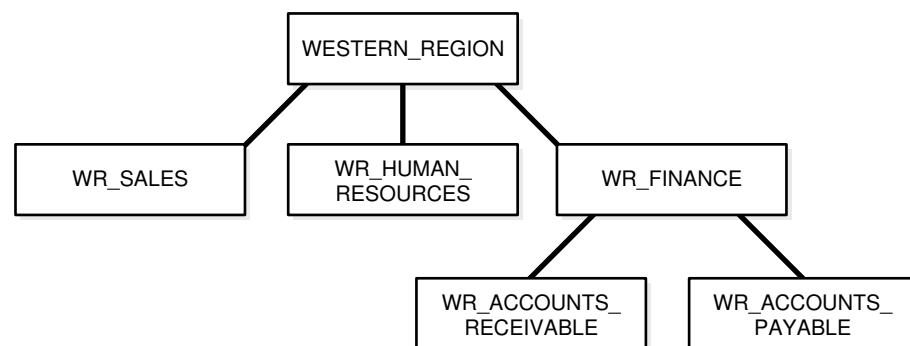
Groups can identify organizations, regions, or other organizing structures that are allowed to access the data, such as `EASTERN_REGION`, `WESTERN_REGION`, `WR_SALES`.

All data pertaining to a certain department can have that department's group name in the label. Groups are useful for the controlled dissemination of data and for timely reaction to organizational change. When a company reorganizes, data access can change right along with the reorganization.

Groups can be hierarchical. You can label data based upon your organizational infrastructure. A group can thus be associated with a parent group.

[Figure 5-2](#) shows how you can define a set of groups corresponding to the following organizational hierarchy.

Figure 5-2 Group Example



The `WESTERN_REGION` group includes three subgroups: `WR_SALES`, `WR_HUMAN_RESOURCES`, and `WR_FINANCE`. The `WR_FINANCE` subgroup is subdivided into `WR_ACCOUNTS_RECEIVABLE` and `WR_ACCOUNTS_PAYABLE`.

Table 5-6 shows how the organizational structure in this example can be expressed in the form of Oracle Label Security groups. The numeric form assigned to the groups affects display order only. You specify the hierarchy (that is, the parent and child relationships) separately. The first group listed, `WESTERN_REGION`, is the parent group of the remaining groups in the table.

Table 5-6 Group Example

Numeric Form	Long Form	Short Form	Parent Group
1000	<code>WESTERN_REGION</code>	<code>WR</code>	
1100	<code>WR_SALES</code>	<code>WR_SAL</code>	<code>WR</code>
1200	<code>WR_HUMAN_RESOURCES</code>	<code>WR_HR</code>	<code>WR</code>
1300	<code>WR_FINANCE</code>	<code>WR_FIN</code>	<code>WR</code>
1310	<code>WR_ACCOUNTS_PAYABLE</code>	<code>WR_AP</code>	<code>WR_FIN</code>
1320	<code>WR_ACCOUNTS_RECEIVABLE</code>	<code>WR_AR</code>	<code>WR_FIN</code>

Table 5-7 shows the forms that you must use when you specify groups.

Table 5-7 Forms of Specifying Groups

Form	Explanation
Numeric form	<p>The numeric form of the group can range from 0 to 9999, and it must be unique for each policy.</p> <p>The numeric form does not indicate any kind of ranking. It does not indicate a parent-child relationship, or greater or less sensitivity. It only controls the display order of the short form group name in the label character string.</p> <p>For example, assume that a label is created that has the level <code>SENSITIVE</code>, the compartment <code>CHEMICAL</code>, and the groups <code>WESTERN_REGION</code> and <code>WR_HUMAN_RESOURCES</code> as listed in Table 5-6. When displayed in string format, the label looks like this:</p> <pre>S:CHEM:WR,WR_HR</pre> <p><code>WR</code> is displayed before <code>WR_HR</code> because 1000 comes before 1200.</p>
Long form	The long form of the group name can contain up to 80 characters.
Short form	The short form can contain up to 30 characters.

Groups are optional. A label can contain up to 10,000 groups.

All labels do not need to have groups. When you analyze the sensitivity of data, you may find that some groups are only used at specific levels. For example, you can specify `HIGHLY_SENSITIVE` and `CONFIDENTIAL` labels with no groups, and a `SENSITIVE` label that does contain groups.

5.4.7 Creating a Policy Label Group

The `SA_COMPONENTS.CREATE_GROUP` procedure creates a label group.

- Run the `SA_COMPONENTS.CREATE_GROUP` procedure for each label group that you need.

In the following example, the first `CREATE_GROUP` procedure creates the parent group, `WR`, and the second procedure associates a second group with the `WR` group by using the `parent_name` parameter.

```
BEGIN
  SA_COMPONENTS.CREATE_GROUP (
    policy_name => 'emp_ols_pol',
    group_num   => 1000,
    short_name  => 'WR',
    long_name   => 'WESTERN_REGION');
END;
/
BEGIN
  SA_COMPONENTS.CREATE_GROUP (
    policy_name => 'emp_ols_pol',
    group_num   => 1100,
    short_name  => 'WR_SAL',
    long_name   => 'WR_SALES',
    parent_name => 'WR');
END;
/
```

Related Topics

- [SA_COMPONENTS.CREATE_GROUP](#)

The `SA_COMPONENTS.CREATE_GROUP` procedure creates a group and specify its short name and long name, and optionally a parent group.

5.4.8 About Associating the Policy Components with a Named Data Label

After defining the label components, you can create a data label itself by associating it with an existing policy.

Optionally, you can include compartments and groups in this association.

You can use Oracle Enterprise Manager Cloud Control or the `SA_LABEL_ADMIN.CREATE_LABEL` procedure. Character string representations of labels use the following syntax:

```
level:compartment1,...,compartmentn:group1,...,groupn
```

The text string that specifies the label can have a maximum of 4,000 characters, including alphanumeric characters, spaces, and underscores. The label names are case-insensitive. You can enter them in uppercase, lowercase, or mixed case, but the string is stored in the data dictionary and displayed in uppercase. Separate each set of components with a colon. You do not need to enter trailing delimiters in this syntax.

For example, you can create valid labels such as these:

```
SENSITIVE:FINANCIAL,CHEMICAL:EASTERN_REGION,WESTERN_REGION
CONFIDENTIAL:FINANCIAL:VP_GRP
SENSITIVE
HIGHLY_SENSITIVE:FINANCIAL
SENSITIVE::WESTERN_REGION
```

5.4.9 Associating the Policy Components with a Named Data Label

The `SA_LABEL_ADMIN.CREATE_LABEL` procedure creates a data label.

- Run `SA_LABEL_ADMIN.CREATE_LABEL`, specifying the policy name and details about the policy components.

For example:

```
BEGIN
  SA_LABEL_ADMIN.CREATE_LABEL (
    policy_name => 'emp_ols_pol',
    label_tag   => '1310',
    label_value => 'S:FINCL,CHEM:ER,WR',
    data_label  => TRUE);
END;
/
```

In this example, the `label_value` setting is in the short form, which translates to the following long form:

```
SENSITIVE:FINANCIAL,CHEMICAL:EASTERN_REGION,WESTERN_REGION
```

When you create a data label, two additional actions occur:

- The label is automatically designated as a valid data label. This functionality limits the labels that can be assigned to data.
- A numeric label tag is associated with the text string representing the label. It is this label tag, rather than the text string, that is stored in the policy label column of the protected table.

 **Note:**

For Oracle Label Security installations that do not use Oracle Internet Directory, dynamic creation of valid data labels uses the `TO_DATA_LABEL` function. Its usage should be tightly controlled.

Related Topics

- [Inserting Labels Using TO_DATA_LABEL](#)
The `TO_DATA_LABEL` function can generate new labels dynamically.
- [SA_LABEL_ADMIN.CREATE_LABEL](#)
The `SA_LABEL_ADMIN.CREATE_LABEL` procedure creates data labels.

5.5 Step 3: Authorize Users for the Label Security Policy

Before users can have access to data that is protected by an Oracle Label Security policy, they must be authorized.

- [About Authorizing Users for Label Security Policies](#)
When you authorize users, you enable them to have access to row data based on the row data label.
- [About Authorizing Levels](#)
You can explicitly set default, minimum, and maximum authorization levels.
- [Authorizing a Level](#)
The `SA_USER_ADMIN.SET_LEVELS` procedure authorizes users for policy levels components.
- [About Authorizing Compartments](#)
After you authorize the user for a specific level, you can optionally specify compartments authorized for the user.

- [Authorizing a Compartment](#)
The `SA_USER_ADMIN.SET_COMPARTMENTS` procedure authorizes a user for the compartments component.
- [About Authorizing Groups](#)
You can specify the list of groups that the user is authorized to be associated with.
- [Authorizing a Group](#)
The `SA_USER_ADMIN.SET_GROUPS` procedure authorizes users for a policy group.

5.5.1 About Authorizing Users for Label Security Policies

When you authorize users, you enable them to have access to row data based on the row data label.

You set the user's authorization by setting their level, zero or more compartments, and zero or more groups as their user label. You can find the currently granted privileges for a user by querying the `DBA_SA_USER_PRIVS` data dictionary view.

5.5.2 About Authorizing Levels

You can explicitly set default, minimum, and maximum authorization levels.

Table 5-8 Authorized Levels Set by the Administrator

Authorization	Meaning
User Max Level	The maximum ranking of sensitivity that a user can access during read and write operations
User Min Level	The minimum ranking of sensitivity that a user can access during write operations. The User Max Level must be equal to or greater than the User Min Level.
User Default Level	The level that is assumed by default when connecting to Oracle Database
User Default Row Level	The level that is used by default when inserting data into Oracle Database

For example, you might set the following level authorizations for user `hpreston`:

Type	Short Name	Long Name	Description
Maximum	HS	HIGHLY_SENSITIVE	User's highest level
Minimum	P	PUBLIC	User's lowest level
Default	C	CONFIDENTIAL	User's default level
Row	C	CONFIDENTIAL	Row level on INSERT

5.5.3 Authorizing a Level

The `SA_USER_ADMIN.SET_LEVELS` procedure authorizes users for policy levels components.

Note that when you specify the levels, you must always use the short names, not the long names.

- Run `SA_USER_ADMIN.SET_LEVELS` to authorize the level, specifying the policy name, user name, and levels.

For example:

```
BEGIN
SA_USER_ADMIN.SET_LEVELS (
  policy_name => 'ols_admin_pol',
  user_name   => 'hpreston',
  max_level   => 'HS',
  min_level   => 'P',
  def_level   => 'C',
  row_level   => 'C');
END;
/
```

Related Topics

- [SA_USER_ADMIN.SET_LEVELS](#)
The `SA_USER_ADMIN.SET_LEVELS` procedure assigns a user minimum and maximum levels and identifies default values for the user's session label and row label.

5.5.4 About Authorizing Compartments

After you authorize the user for a specific level, you can optionally specify compartments authorized for the user.

Write access must be explicitly given for each compartment. A user cannot directly insert, update, or delete a row that contains a compartment that the user does not have authorization to write.

For example, you could set the following compartment authorizations for user `hpreston`:

Short Name	Long Name	WRITE	DEFAULT	ROW
CHEM	CHEMICAL	YES	YES	NO
FINCL	FINANCIAL	YES	YES	NO
OP	OPERATIONAL	YES	YES	YES

5.5.5 Authorizing a Compartment

The `SA_USER_ADMIN.SET_COMPARTMENTS` procedure authorizes a user for the compartments component.

When you specify the compartments, you must use their short names, not their long names.

- Run `SA_USER_ADMIN.SET_COMPARTMENTS` to authorize a user for a compartment, specifying the policy name, user name, and compartment details.

For example:

```
BEGIN
SA_USER_ADMIN.SET_COMPARTMENTS (
  policy_name => 'ols_admin_pol',
  user_name   => 'hpreston',
  read_comps  => 'FINCL',
  write_comps => 'FINCL',
  def_comps   => 'FINCL',
  row_comps   => 'FINCL');
END;
```

```
END;  
/
```

After you have run this procedure, you can authorize the user for additional compartments by running the `SA_USER_ADMIN.ADD_COMPARTMENTS` procedure.

Related Topics

- [SA_USER_ADMIN.SET_COMPARTMENTS](#)
The `SA_USER_ADMIN.SET_COMPARTMENTS` procedure assigns compartments to a user and identifies default values for the user's session label and row label.
- [SA_USER_ADMIN.ADD_COMPARTMENTS](#)
The `SA_USER_ADMIN.ADD_COMPARTMENTS` procedure adds (assigns) compartments to a user's authorizations, indicating if the compartments are authorized for write and read privileges.

5.5.6 About Authorizing Groups

You can specify the list of groups that the user is authorized to be associated with.

Write access must be explicitly given for each group listed.

For example, you could set the following group authorizations:

Short Name	Long Name	WRITE	DEFAULT	ROW	Parent
WR_HR	WR_HUMAN_RESOURCES	YES	YES	YES	WR
WR_AP	WR_ACCOUNTS_PAYABLE	YES	YES	NO	WR_FIN
WR_AR	WR_ACCOUNTS_RECEIVABLE	YES	YES	NO	WR_FIN

Defining group parent associations is done as part of the group definition.

5.5.7 Authorizing a Group

The `SA_USER_ADMIN.SET_GROUPS` procedure authorizes users for a policy group.

- Run `SA_USER_ADMIN.SET_GROUPS` to authorize the user, specifying the policy name, user name, and authorizations that you want. When you specify the groups, you must use the short name, not the long name.

For example:

```
BEGIN  
  SA_USER_ADMIN.SET_GROUPS (  
    policy_name => 'ols_admin_pol',  
    user_name   => 'hpreston',  
    read_groups => 'WR_AP',  
    write_groups => 'WR_AP',  
    def_groups  => 'WR_AP',  
    row_groups  => 'WR_AP');  
END;  
/
```

After you have run this procedure, you can authorize the user for additional groups by running the `SA_USER_ADMIN.ADD_GROUPS` procedure.

Related Topics

- [SA_USER_ADMIN.SET_GROUPS](#)
The `SA_USER_ADMIN.SET_GROUPS` procedure assigns groups to a user and identifies default values for the user's session label and row label.

5.6 Step 4: Grant Privileges to Users and Trusted Stored Program Units

Oracle Label Security supports special privileges that allow authorized users to bypass certain parts of the policy

- [About Granting Privileges to Users and Trusted Program Units for the Policy](#)
Certain authorized users and trusted program units may need special privileges to bypass parts of the OLS policy.
- [Granting Privileges to a User](#)
The `SA_USER_ADMIN.SET_USER_PRIVS` procedure grants users privileges.
- [Granting Privileges to a Trusted Program Unit](#)
The `SA_USER_ADMIN.SET_PROG_PRIVS` procedure grants privileges to trusted program units.

5.6.1 About Granting Privileges to Users and Trusted Program Units for the Policy

Certain authorized users and trusted program units may need special privileges to bypass parts of the OLS policy.

Trusted program units are functions, procedures, or packages that are granted Oracle Label Security privileges. You create a trusted stored program unit in the same way that you create a standard procedure, function, or package, that is by using the `CREATE PROCEDURE`, `CREATE FUNCTION`, or `CREATE PACKAGE` and `CREATE PACKAGE BODY` statements. The program unit becomes trusted when you grant Oracle Label Security privileges to it.

[Table 5-9](#) summarizes the special privileges that can be granted to users or trusted stored program units.

Table 5-9 Oracle Label Security Privileges

Security Privilege	Explanation
READ	Allows read access to all data protected by the policy
FULL	Allows full read and write access to all data protected by the policy
COMPACCESS	Bypasses the group component check if the session label level and compartment(s) dominate the data level and compartments
PROFILE_ACCESS	Allows a session to change its labels and privileges to those of a different user
WRITEUP	Allows users to set or raise only the level, within a row label, up to the maximum level authorized for the user. (Active only if <code>LABEL_UPDATE</code> is active.)

Table 5-9 (Cont.) Oracle Label Security Privileges

Security Privilege	Explanation
WRITEDOWN	Allows users to set or lower the level, within a row label, to any level equal to or greater than the minimum level authorized for the user. (Active only if LABEL_UPDATE is active.)
WRITEACROSS	Allows a user to set or change groups and compartments of a row label, but does not allow changes to the level. (Active only if LABEL_UPDATE is active.)

5.6.2 Granting Privileges to a User

The `SA_USER_ADMIN.SET_USER_PRIVS` procedure grants users privileges.

- Run `SA_USER_ADMIN.SET_USER_PRIVS`, specifying the policy name, user name, and privileges that you want to grant.

For example:

```
BEGIN
  SA_USER_ADMIN.SET_USER_PRIVS (
    policy_name => 'ols_admin_pol',
    user_name   => 'hpreston',
    privileges  => 'WRITEDOWN');
END;
/
```

Related Topics

- [SA_USER_ADMIN.SET_USER_PRIVS](#)
The `SA_USER_ADMIN.SET_USER_PRIVS` procedure sets policy-specific privileges for users.

5.6.3 Granting Privileges to a Trusted Program Unit

The `SA_USER_ADMIN.SET_PROG_PRIVS` procedure grants privileges to trusted program units.

- Run `SA_USER_ADMIN.SET_PROG_PRIVS` to grant the privileges, specifying the policy name, schema name, program unit name, and privileges that you want to grant.

For example:

```
BEGIN
  SA_USER_ADMIN.SET_PROG_PRIVS (
    policy_name      => 'oe_ols_pol',
    schema_name      => 'oe',
    program_unit_name => 'check_order_updates',
    privileges        => 'READ');
END;
/
```

Related Topics

- [SA_USER_ADMIN.SET_PROG_PRIVS](#)
The `SA_USER_ADMIN.SET_PROG_PRIVS` procedure sets policy-specific privileges for program units.

5.7 Step 5: Apply the Policy to a Database Table or Schema

After you create grant authorizations and privileges to an Oracle Label Security policy, you can apply it to a database table or schema.

- [About Applying the Policy to a Database Table or Schema](#)
When you apply a policy to a table, the policy is automatically enabled.
- [Applying a Policy to a Schema](#)
The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` applies a policy to a table within a schema and the `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to an entire schema.

5.7.1 About Applying the Policy to a Database Table or Schema

When you apply a policy to a table, the policy is automatically enabled.

To disable a policy is to turn off its protections, although it is still applied to the table. To enable a policy is to turn on and enforce its protections for a particular table or schema.

To remove a policy is to take it entirely away from the table or schema. Note, however, that the policy label column and the labels remain in the table unless you explicitly drop them.

You can alter the default policy enforcement options for future tables that may be created in a schema. This does not, however, affect policy enforcement options on existing tables in the schema.

To change the enforcement options on an existing table, you must first *remove* the policy from the table, make the desired changes, and then reapply the policy to the table.

In cases where a master-detail table relationship exists with primary and foreign keys, only one of the tables needs to be protected by an OLS policy. The other table will also be protected based on the key relationship.

Be aware that you cannot enforce Oracle Label Security policies on external tables.

After you have created the policy components and configured user authorizations, privileges, and auditing for them, you can apply the policy to a database table or to an entire schema.

When you apply the policy to a database table, in addition to the policy name and target schema table, you must specify the following information:

- `table_options`: A comma-delimited list of policy enforcement options to be used for the table. If `NULL`, then the policy's default options are used.
- `label_function`: A string calling a function to return a label value to use as the default. For example, `my_label(:new.dept,:new.status)` computes the label based on the new values of the `DEPT` and `STATUS` columns in the row.
- `predicate`: An additional predicate to combine (using `AND` or `OR`) with the label-based predicate for `READ_CONTROL`

Note the following aspects of using Oracle Label Security policies with schemas:

- If you apply a policy to an empty schema, then every time you create a table within that schema, the policy is applied. Once the policy is applied to the schema, the default options you choose are applied to every table added.

- If you remove the policy from a table so that it is unprotected, and then run `SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY`, then the table will remain unprotected. If you wish to protect the table once again, then you must apply the policy to the table, or re-apply the policy to the schema.

If you apply a policy to a schema that already contains tables protected by the policy, then all future tables will have the new options that were specified when you applied the policy. The existing tables will retain the options they already had.

5.7.2 Applying a Policy to a Schema

The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` applies a policy to a table within a schema and the `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to an entire schema.

- Run `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` to apply the policy to a table, specifying the policy name, schema name, and necessary options.

The following example shows how to use the `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` procedure to apply the `ols_admin_pol` policy to the `HR.EMPLOYEES` table.

```
BEGIN
  SA_USER_ADMIN.APPLY_TABLE_POLICY (
    policy_name    => 'ols_admin_pol',
    schema_name    => 'hr',
    table_name     => 'employees',
    table_options  => 'READ_CONTROL,WRITE_CONTROL,CHECK_CONTROL',
    label_function => 'hr.gen_emp_label(:new.department_id,:new.salary',
    predicate      => NULL);
END;
/
```

This example shows how to use the `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure to apply a policy to an entire schema.

```
BEGIN
  SA_USER_ADMIN.APPLY_SCHEMA_POLICY (
    policy_name    => 'ols_admin_pol',
    schema_name    => 'hr',
    default_options => NULL);
END;
/
```

Related Topics

- [SA_POLICY_ADMIN.APPLY_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` procedure adds the specified policy to a table.
- [SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to all of the tables in a schema and enables the policy for these tables.

5.8 Step 6: Add Policy Data Labels to Table Rows

You must add policy data labels to table rows.

- [About Adding Policy Data Labels to Table Rows](#)
After you have applied a policy to a table, you must add data labels to the rows in the table.

- [Adding a Policy Data Label to a Table Row](#)
You must update the table to which you are adding a policy label.

5.8.1 About Adding Policy Data Labels to Table Rows

After you have applied a policy to a table, you must add data labels to the rows in the table.

These labels are stored in the policy label column that you created earlier in the table. The user updating the table must have the `FULL` security privilege for the policy. This user is normally the owner of the table.

5.8.2 Adding a Policy Data Label to a Table Row

You must update the table to which you are adding a policy label.

1. To add data labels to a table, in SQL*Plus, enter an `UPDATE` statement using the following syntax:

```
UPDATE table_name
SET ols_column = CHAR_TO_LABEL('ols_policy','data_label')
WHERE UPPER(table_column) IN (column_data);
```

For example, suppose `LABCSYS` has created a policy called `ACCESS_LOCATIONS` and wants to add the label `SENS` to the cities Beijing, Tokyo, and Singapore in the `HR.LOCATIONS` table. The policy label column is called `ROW_LABEL`. The `UPDATE` statement is as follows:

```
UPDATE LOCATIONS
SET ROW_LABEL = CHAR_TO_LABEL('ACCESS_LOCATIONS','SENS')
WHERE UPPER(city) IN ('BEIJING', 'TOKYO', 'SINGAPORE');
```

2. Run the following `SELECT` statement to ensure that the policy was added to the table:

```
SELECT LABEL_TO_CHAR (ROW_LABEL) FROM LOCATIONS;
```

5.9 Step 7: Optionally, Configure Auditing

For Oracle Label Security policies, if you want to enable auditing, then you must create a unified audit policy.

1. Log in to the database instance as a user who has the `LBAC_DBA` database role and the `AUDIT_ADMIN` system privilege.
2. Create the unified audit policy for the Oracle Label Security policy.

For example:

```
CREATE AUDIT POLICY ols_admin_pol
ACTIONS UPDATE ON HR.EMPLOYEES, DELETE ON HR.EMPLOYEES
ACTIONS COMPONENT=OLS DROP POLICY, DISABLE POLICY;
```

3. Enable this unified audit policy.

For example:

```
AUDIT POLICY ols_admin_pol;
```

The audit record will be written to the unified audit trail, viewable with the UNIFIED_AUDIT_TRAIL data dictionary view. For example:

```
SELECT OLS_PRIVILEGES_USED FROM UNIFIED_AUDIT_TRAIL  
WHERE OLS_POLICY_NAME = 'OLS_ADMIN_POL' AND DBUSERNAME = 'PSMITH';
```

Related Topics

- [Oracle Database Security Guide](#)

5.10 Using Oracle Label Security Policies and Oracle Flashback Data Archive

Oracle Label Security policies do not automatically work with Oracle Flashback Data Archive (FDA).

After you create an Oracle Label Security policy for a table, consider creating an equivalent policy for the Flashback Data Archive (FDA) history table.

1. Find the object ID for the table to which you attached the Oracle Label Security policy.

For example, suppose you attached an Oracle Label Security policy to the HR.LOCATIONS table:

```
SELECT OBJECT_ID FROM DBA_OBJECTS WHERE OBJECT_NAME='LOCATIONS' AND  
OWNER='HR';
```

2. Use this object ID to create a policy container for the history table that is associated with the Oracle Label Security policy's associated table.

5.11 Using Enterprise Manager Cloud Control to Create an OLS Policy

You can create Oracle Label Security policies in Oracle Enterprise Manager Cloud Control. However, you cannot create audit policies using Cloud Control; you must use SQL*Plus to create unified audit policies.

- [Creating the Label Security Policy Container Using Cloud Control](#)
You can create the Oracle Label Security policy container in Cloud Control.
- [Creating Policy Components Using Cloud Control](#)
After you create a container for the policy and set enforcement options for it, you can create components for the policy.
- [Creating Data Labels for the Policy Using Cloud Control](#)
You can create data labels for an Oracle Label Security policy in Cloud Control.
- [Authorizing and Granting Privileges for a Policy Using Cloud Control](#)
You can authorize and grant privileges to users for a policy during the user creation process.
- [Granting Privileges to Trusted Program Units Using Cloud Control](#)
You can grant privileges to trusted program units in Cloud Control.
- [Applying a Policy to a Database Table with Cloud Control](#)
You can apply an Oracle Label Security policy to a database table in Cloud Control.

- [Applying Policy Data Labels to Table Rows Using Cloud Control](#)
You can apply Oracle Label Security policy data labels to table rows in Cloud Control.

5.11.1 Creating the Label Security Policy Container Using Cloud Control

You can create the Oracle Label Security policy container in Cloud Control.

1. Log in to Cloud Control as the `SYSTEM` user.
2. To navigate to your database, select **Databases** from the **Targets** menu.
3. Click the database name in the list that appears.

The database page appears.

4. Under the **Administration** menu, select **Security, Oracle Label Security**. The Label Security Policies page appears.

You may be required to log in to the database with the credentials of an Oracle Label Security administrator.

5. Click **Create** to start creating a new label security policy. The Create Label Security Policy page appears.
6. Define the policy's name, label column, and the default policy enforcement options.
 - **Name:** Enter a name for the policy, for example, `access_locations`.
 - **Label Column:** (Optional) Enter a name for the label column, for example, `OLS_COLUMN`. If you create an OLS policy without specifying the column name, the column name is auto-generated as `Pol_name_COL`. Later on, when you apply the policy to a table, the label column is added to that table. By default, the data type of the policy label column is `NUMBER(10)`. You can also specify an existing table column of the `NUMBER(10)` data type as the label column.
 - **Hide Label Column:** Select to hide the column. When you first create the policy, you may want to disable **Hide Label Column** during the development phase of the policy. When the policy is satisfactory and ready for use by users, hide the column so that it is transparent to applications.
 - **Enabled:** Toggle to enable or disable the policy.
 - **Default Policy Enforcement Options:** The default policy enforcement options are used when the policy is applied. Ensure that these meet the needs of the application to which you are applying the policy.

Select from the following options:

- **Apply No Policy Enforcements (NO_CONTROL)**
- **Apply Policy Enforcements**
 - For all queries (READ_CONTROL)**
 - For Insert operations (INSERT_CONTROL)**
 - For Update Operations (UPDATE_CONTROL)**
 - Use session's default label for label column update (LABEL_DEFAULT)**
 - Operations that update the label column (LABEL_UPDATE)**
 - Update and Insert operations so that they are read accessible (CHECK_CONTROL)**

7. Click **OK**.

The new policy appears in the Oracle Label Security Policies page. After you create this policy container, Oracle Label Security creates and grants a role to you named after the policy (for example, `ACCESS_LOCATIONS_DBA`), which enables you to manage this policy during its lifetime.

5.11.2 Creating Policy Components Using Cloud Control

After you create a container for the policy and set enforcement options for it, you can create components for the policy.

1. In the Oracle Label Security Policies page, select the policy you just created. Click **Edit**.
2. In the Edit Label Security Policy page, select the **Label Components** tab.
3. Click **Add 5 Rows** under Levels to add levels for the policy. Enter a Long Name, Short Name, and Numeric Tag for each level that you create. The numeric tag corresponds to the sensitivity of the level. To create more levels, you can click **Add 5 Rows** again. Use the same steps to create compartments and rows. For compartments and groups, the numeric tags do not correspond to sensitivity.

At a minimum, you must create one level, such as `SECRET`. Creating compartments and groups is optional.

The level numbers indicate the level of sensitivity for their corresponding labels. A greater number implies greater sensitivity. Select a numeric range that can be expanded later on, in case your security policy needs more levels. For example, if you have created levels `PUBLIC (7000)` and `SENSITIVE (8000)`, and you now want to create an intermediate level called `CONFIDENTIAL`, then you can assign the numeric value 7500 to this level.

Compartments identify categories associated with data, providing a finer level of granularity within a level. For example, a single table might have data corresponding to different departments that you might like to separate using compartments. Compartments are optional.

Groups identify organizations owning or accessing the data. Groups are useful for the controlled dissemination of data and for timely reaction to organizational change. Groups are optional.

4. Click **Apply**.

5.11.3 Creating Data Labels for the Policy Using Cloud Control

You can create data labels for an Oracle Label Security policy in Cloud Control.

1. In the Label Security Policies page, select the policy that needs to have labels linked to levels.
2. In the **Actions** box, select Data Labels. Click **Go**.

The Data Labels page appears.

3. Click **Add**.

The Create Data Label page appears.

4. Enter the following information:
 - **Numeric Tag:** Enter a number that uniquely identifies the label. This number should be unique across all policies.
 - **Level:** Select a level from the list.

5. You can optionally select Compartments to add to the label. To add compartments, click **Add** under Compartments. Select the compartments to be added to the label. Click **Select** to add the compartments.
6. Optionally, to add groups, click **Add** under **Groups**. Select the groups to be added to the label. Click **Select** to add the groups.
7. Click **OK** in the Create Data Label page.
The data label appears in the Data Labels page.
8. Repeat steps 3 to 7 to create more data labels.

Alternatively, you can use the `SA_LABEL_ADMIN` package to define label components for a policy.

Related Topics

- [SA_LABEL_ADMIN Label Management PL/SQL Package](#)
The `SA_LABEL_ADMIN` PL/SQL package provides an administrative interface to manage the labels used by a policy.

5.11.4 Authorizing and Granting Privileges for a Policy Using Cloud Control

You can authorize and grant privileges to users for a policy during the user creation process.

1. In the Label Security Policies page, select the policy that needs authorization.
2. In the **Actions** box, select **Authorization**. Click **Go**.
The Create User page appears.
3. Add users as follows:
 - Under Database Users, click **Add**. In the Search and Select window, select users that you want and then click **Select**.
 - Under Non Database Users, click **Add 5 Rows**, and then add the user names of the non-database users that you want to add. Most application users are considered non-database users. A non-database user does not exist in the database. This can be any user name that meets the Oracle Database naming standards and can fit into the `VARCHAR2(30)` length field. However, be aware that Oracle Database does not automatically configure the associated security information for the non-database user when the application connects to the database. In this case, the application needs to call an Oracle Label Security function to assume the label authorizations of the specified user who is not a real database user.
4. In the Create User page, select the user that you want to authorize. Click **Next**. If you have multiple users that need the same authorizations, then select all users who need the same authorizations. Click **Next**.
The Privileges step appears.
5. Next, you can assign privileges to the user you selected in the preceding step. Privileges allow a database user to bypass certain controls enforced by the policy. Select the privileges you want to grant. Click **Next**.
If you do not want to assign any privileges to the user, then click **Next** without selecting any privileges.
The Labels, Compartments, and Groups step appears.
6. Next, to create the user label for the user: under Levels, use the flashlight icon to select data to enter for the following fields:

- **Maximum Level:** Enter the highest level for read and write access for this user.
 - **Minimum Level:** Enter the lowest level for write access.
 - **Default Level:** Enter the default level when the user logs in.
This value is equal to or greater than the minimum level and equal to or less than the maximum level.
 - **Row Level:** Enter the level given to the row when user writes to the table.
7. Click **Add** under Compartments, to add compartments to the user label. Select the compartments to add. Click **Select**.
 8. For each compartment that you add, you can select the following properties:
 - **Write:** Allows the user to write to data that has the compartment as part of its label
 - **Default:** Adds the compartment to the user's default session label
 - **Row:** Adds the compartment to the data label when the user writes to the table
 9. Click **Add** under Groups, to add groups to the user label. Select the groups and click **Select**.
 10. For each group that you add, you can select the following properties:
 - **Write:** Allows the user to write to data that has the group as part of its label
 - **Default:** Adds the group to the user's default session label
 - **Row:** Adds the group to the data label when the user writes to the table
 11. Click **Next**.
The Audit step appears.
 12. Bypass the Audit step by clicking **Next**.
You cannot configure traditional auditing in a new Oracle Label Security policy. Instead, you must create a unified audit policy using SQL*Plus.
 13. You can review the policy authorization settings. Click **Finish** to create the policy authorization. Alternatively, you can click **Back** to modify the authorization settings.
Alternatively, you can use the `SA_USER_ADMIN` package to authorize users.

5.11.5 Granting Privileges to Trusted Program Units Using Cloud Control

You can grant privileges to trusted program units in Cloud Control.

1. In the Label Security Policies page, select the policy that needs authorization.
2. In the **Actions** box, select Authorization. Click **Go**.
The Authorization page appears.
3. Click the **Trusted Program Units** tab.
4. Click **Add** to add Oracle Label Security privileges for a procedure, function, or package.
The **Create Program Unit** page appears.
5. Enter the name of the procedure, function, or package, for which the privileges need to be granted, in the **Program Unit** field. You can also use the **Search** icon to search for the procedure, function, or package.
6. Select one or more policy-specific privileges that need to be granted to the program unit. Click **OK**.

The trusted program unit is added to the Authorizations page.

Alternatively, you can use the **SA_USER_ADMIN** package to authorize trusted program units.

Related Topics

- [Administering and Using Trusted Stored Program Units](#)
You can use trusted stored program units to enhance system security.

5.11.6 Applying a Policy to a Database Table with Cloud Control

You can apply an Oracle Label Security policy to a database table in Cloud Control.

1. In the Label Security Policies page, select the policy that needs to be applied to a table.
2. Select Apply from the **Actions** box. Click **Go**.

The Apply page appears.

3. Select the **Tables** tab to apply the policy to a table.

Select the **Schemas** tab if you are applying the policy to a schema. The process is same as applying the policy to a table.

4. Click **Create**.

The Add Table page appears.

5. Next to the **Table** box, click the flashlight icon.

6. In the Search and Select window, enter the following information under Search:

- **Schema:** Enter the name of the schema in which the table appears. Leaving this field empty displays tables in all schemas.
- **Name:** Optionally, enter the name of the table. Leaving this box empty displays all the tables within the schema.

To narrow the search by using wildcards, use the percent (%) sign. For example, enter O% to search for all tables beginning with the letter O.

7. Select the table and click **Select**.

The Add Table page appears.

8. Enter the following information:

- **Policy Enforcement Options:** Select enforcement options as needed. These options will apply to the table on top of the enforcement options that you selected when you created the label security policy container.

To make no change from those enforcement options, that is, to use the same enforcement options created earlier, select **Use Default Policy Enforcement**. To add more enforcement options, select from the other options listed.

- **Labeling Function:** Optionally, specify a labeling function to automatically compute the label to be associated with a new or updated row. That function is always invoked thereafter to provide the data labels written under that policy, because active labeling functions take precedence over any alternative means of supplying a label.
- **Predicate:** Optionally, specify an additional predicate to combine (using **AND** or **OR**) with the label-based predicate for `READ_CONTROL`.

9. Click **OK**.

Related Topics

- [Step 1: Create the Label Security Policy Container](#)
The Oracle Label Security policy container is a storage place for the policy settings.

5.11.7 Applying Policy Data Labels to Table Rows Using Cloud Control

You can apply Oracle Label Security policy data labels to table rows in Cloud Control.

1. In the Label Security Policies page, select the policy, for example, `ACCESS_LOCATIONS`.
2. Select Authorization from the **Actions** box. Click **Go**.
The Authorization page appears.
3. Click **Add**.
The Create User page appears.
4. Under Database Users, click **Add**.
The Search and Select window appears.
5. Select the check box corresponding to the user that owns the table. Click **Select**.
The Create User page lists the user that was added.
6. Click **Next**.
The Privileges step appears.
7. Select the appropriate privileges for the user, and then click **Next**.
The Labels, Compartments, and Groups page appears.
8. Click **Next**.
The Audit step appears.
9. Click **Next**.
The Review step appears.
10. Click **Finish**.

6

Working with Labeled Data

You can manage labeled data, view session security attributes, and change the value of session attributes.

Note:

Many of the examples in this guide use the human resources sample policy. Its policy name is `HR` and its policy label column is `HR_LABEL`. Unless otherwise noted, the examples assume that the SQL statements are performed on rows within the user's authorization and with full Oracle Label Security policy enforcement in effect.

- [How Policy Label Column and Label Tags Work](#)
You should understand how policy label columns in a table or schema are created and filled.
- [The Policy Label Column](#)
A Policy Label Column is created when a policy is applied to a table.
- [Label Tags](#)
You can create label tags that represent the label components automatically or manually.
- [Assignments of Labels to Data Rows](#)
For existing data rows, labels can be assigned by a labeling function that you create.
- [Viewing the Label](#)
When you retrieve labels, you do not automatically obtain the character string value.
- [Filtration of Data Using Labels](#)
When SQL statements are processed, Oracle Label Security makes calls to the security policies defined in the database by create-and-apply procedures.
- [Inserting Labeled Data](#)
You can insert labeled data in a variety of situations.
- [Changing Session and Row Labels](#)
During a session, a user can change labels based on the authorizations an administrator sets.

6.1 How Policy Label Column and Label Tags Work

You should understand how policy label columns in a table or schema are created and filled.

6.2 The Policy Label Column

A Policy Label Column is created when a policy is applied to a table.

- [About the Policy Label Column](#)
Each policy that is applied to a table creates a column in the database.

- [Hiding the Policy Label Column](#)
You can choose not to display the column representing a policy.

6.2.1 About the Policy Label Column

Each policy that is applied to a table creates a column in the database.

By default, the data type of the label column is `NUMBER`.

Each row's label for that policy is represented by a tag in that column, using the numeric equivalent of the character-string label value. The label tag is automatically generated when the label is created, unless the administrator specifies the tag manually at that time.

The automatic label generation follows the rules established by the administrator while defining the label components.

Note:

The act of creating a policy does not in itself have any effect on tables or schemas. It only applies the policy to a table or schema.

Related Topics

- [Understanding Data Labels and User Labels](#)
You should understand fundamental concepts of data labels and user labels.

6.2.2 Hiding the Policy Label Column

You can choose not to display the column representing a policy.

Note:

You cannot hide columns in materialized views.

- To hide the display of a column, apply the `HIDE` option to the table.

After a policy using `HIDE` is applied to a table, a user running a `SELECT *` or performing a `DESCRIBE` operation will not see the policy label column. If the policy label column is not hidden, then the label tag is displayed as data type `NUMBER`.

The following example shows the output of the `EMP` table, with the `HR_LABEL` column showing:

```
DESCRIBE EMP;
Name                               Null?    Type
-----
EMPNO                               NOT NULL NUMBER(4)
ENAME                               CHAR(10)
JOB                                  CHAR(9)
MGR                                  NUMBER(4)
SAL                                  NUMBER(7,2)
DEPTNO                              NOT NULL NUMBER(2)
HR_LABEL                             NUMBER(10)
```

Here is how the same table appears with the `HR_LABEL` column hidden:


```

DESCRIBE EMP;
Name                               Null?    Type
-----
EMPNO                               NOT NULL NUMBER(4)
ENAME                               CHAR(10)
JOB                                  CHAR(9)
MGR                                  NUMBER(4)
SAL                                  NUMBER(7,2)
DEPTNO                              NOT NULL NUMBER(2)

```

Related Topics

- [How the HIDE Policy Column Option Works](#)
You can specify the `HIDE` policy configuration option when you add an Oracle Label Security policy column to a table.

6.3 Label Tags

You can create label tags that represent the label components automatically or manually.

- [About Label Tags](#)
Label tags represent data labels created for a policy.
- [Manually Defined Label Tags to Order Labels](#)
By manually defining label tags, you can implement a data manipulation strategy that permits labels to be meaningfully sorted and compared.
- [Manually Defined Label Tags to Manipulate Data](#)
An administratively defined label tag is a convenient way to reference a complete label string (that is, a combination of label components).
- [Automatically Generated Label Tags](#)
Dynamically generated label tags have 10 digits, with no relationship to numbers assigned to any label component.

6.3.1 About Label Tags

Label tags represent data labels created for a policy.

When creating data labels, the administrator specifies the set of valid combinations of components that can make up a label, that is, a level optionally combined with one or more groups or compartments.

Each such valid data label within a policy is uniquely identified by an associated numeric tag assigned by the administrator or generated automatically upon its first use. Manual definition has the advantage of allowing the administrator to control the ordering of label values when they are sorted or logically compared.

However, label tags must be unique across all policies in the database. When you use multiple policies in a database, you cannot use the same numeric label tag in different policies. Remember that each label tag uniquely identifies one label, and that numeric tag is what is stored in the data rows, not the label's character-string representation.

6.3.2 Manually Defined Label Tags to Order Labels

By manually defining label tags, you can implement a data manipulation strategy that permits labels to be meaningfully sorted and compared.

To do this, you must predefine all of the labels to be associated with protected data, and assign to each label a meaningful label tag value. Manually assigned label tags can have up to eight digits. The value of a label tag must be greater than zero.

It may be advantageous to implement a strategy in which label tag values are related to the numeric values of label components. In this way, you can use the tags to group data rows in a meaningful way. This approach, however, is not mandatory. It is good practice to set tags for labels of higher sensitivity to a higher numeric value than tags for labels of lower sensitivity.

[Table 6-1](#) illustrates a set of label tags that have been assigned.

Table 6-1 Administratively Defined Label Tags (Example)

Label Tag	Label String
10000	P
20000	C
21000	C:FNCL
21100	C:FNCL,OP
30000	S
31110	S:OP:WR
40000	HS
42000	HS:OP

In this example, labels with a level of `PUBLIC` begin with "1", labels with a level of `CONFIDENTIAL` begin with "2", labels with a level of `SENSITIVE` begin with "3", and labels with a level of `HIGHLY_SENSITIVE` begin with "4".

Labels with the `FINANCIAL` compartment then come in the 1000 range, labels with the compartment `OP` are in the 1100 range, and so on. The tens place is used to indicate the group `WR`, for example.

Another strategy might be completely based on groups, where the tags might be 3110, 3120, 3130, and so on.

Note, however, that label tags identify the *whole* label, independent of the numeric values assigned for the individual label components. The label tag is used as a whole integer, not as a set of individually evaluated numbers.

Related Topics

- [Understanding Data Labels and User Labels](#)
You should understand fundamental concepts of data labels and user labels.

6.3.3 Manually Defined Label Tags to Manipulate Data

An administratively defined label tag is a convenient way to reference a complete label string (that is, a combination of label components).

For example, the tag "31110" could stand for the complete label string "S:OP:WR".

Label tags can be used as a convenient way to partition data. This will be useful if you need to store different levels of sensitive data on different disk drives. For example, all data with labels in the range 1000 - 1999 could be placed in tablespace A, all data with labels in the range 2000 - 2999 could be placed in tablespace B, and so on.

This simplified notation also comes in handy when there is a finite number of labels and you need to perform various operations upon them. Consider a situation in which one company hosts a human resources system for many other companies. Assume that all users from Company Y have the label "C:ALPHA:CY", for which the tag "210" has been set. To determine the total number of users from Company Y, the host administrator can enter:

```
SELECT * FROM tabl
WHERE hr_label = 210;
```

6.3.4 Automatically Generated Label Tags

Dynamically generated label tags have 10 digits, with no relationship to numbers assigned to any label component.

You cannot group the data by label.

[Table 6-2](#) describes how automatically generated label tags work.

Table 6-2 Generated Label Tags (Example)

Label Tag	Label String
10000020	P
10000052	C
10000503	C:FNCL
10000132	C:FNCL,OP
10000003	S
10000780	S:OP:WR
10000035	HS
10000036	HS:OP

6.4 Assignments of Labels to Data Rows

For existing data rows, labels can be assigned by a labeling function that you create.

In such a function, you specify the exact table and row conditions defining what label to insert. The function can be named in the call to apply a policy to a table or schema, or in an update by the administrator.

Related Topics

- [Inserting Labeled Data](#)
You can insert labeled data in a variety of situations.
- [Labeling Functions](#)
Labeling functions can compute and return a label using resources such as context variables (for example, date or username) and data values.
- [SA_POLICY_ADMIN.APPLY_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` procedure adds the specified policy to a table.
- [SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to all of the tables in a schema and enables the policy for these tables.

6.5 Viewing the Label

When you retrieve labels, you do not automatically obtain the character string value.

By default, the label tag value is returned. Two label manipulation functions enable you to convert the label tag value to and from its character string representation.

- [Converting a Character String to a Label Tag with CHAR_TO_LABEL](#)
The `CHAR_TO_LABEL` function converts character strings to a label tag, returning the label tag for the specified character string.
- [Conversion of a Label Tag to a Character String, with LABEL_TO_CHAR](#)
You can convert label tags to character strings.

6.5.1 Converting a Character String to a Label Tag with CHAR_TO_LABEL

The `CHAR_TO_LABEL` function converts character strings to a label tag, returning the label tag for the specified character string.

- To convert a character string to a label tag, use the following syntax for the `CHAR_TO_LABEL` function:

```
FUNCTION CHAR_TO_LABEL (  
    policy_name    IN VARCHAR2,  
    label_string   IN VARCHAR2)  
RETURN NUMBER;
```

For example:

```
INSERT INTO emp (empno,hr_label)  
VALUES (999, CHAR_TO_LABEL('HR','S:A,B:G5'));
```

6.5.2 Conversion of a Label Tag to a Character String, with LABEL_TO_CHAR

You can convert label tags to character strings.

- [Converting a Label Tag to a Character String with LABEL_TO_CHAR](#)
The `LABEL_TO_CHAR` function returns a `VARCHAR2` string when it converts a label tag to a character string.
- [LABEL_TO_CHAR Examples](#)
Oracle provides examples that illustrate the use of `LABEL_TO_CHAR`.
- [Retrieving All Columns from a Table When the Policy Label Column Is Hidden](#)
If the policy label column is hidden, then it is not automatically returned when you run `SELECT *` on the table.

6.5.2.1 Converting a Label Tag to a Character String with LABEL_TO_CHAR

The `LABEL_TO_CHAR` function returns a `VARCHAR2` string when it converts a label tag to a character string.

When you query a table or view, you automatically retrieve all of the rows in the table or view that satisfy the qualifications of the query and are dominated by your label. If the policy label column is not hidden, then the label tag value for each row is displayed. You must use the `LABEL_TO_CHAR` function to display the character string value of each label. Note that all

conversions must be explicit. There is no automatic casting to and from tag and character string representations.

- To convert a label tag to a character string, use the following syntax for the `LABEL_TO_CHAR` function:

```
FUNCTION LABEL_TO_CHAR (
    label IN NUMBER)
RETURN VARCHAR2;
```

6.5.2.2 LABEL_TO_CHAR Examples

Oracle provides examples that illustrate the use of `LABEL_TO_CHAR`.

Example: Retrieving a Row Label from a Table or a View

To retrieve the label of a row from a table or view, specify the policy label column in the `SELECT` statement.

```
SELECT label_to_char (hr_label) AS label, ename FROM tabl
WHERE ename = 'RWRIGHT';
```

This statement returns the following:

LABEL	ENAME
-----	-----
S:A,B:G1	RWRIGHT

Example: Retrieving a Policy Label Column

You can also specify the policy label column in the `WHERE` clause of a `SELECT` statement.

The following statement displays all rows that have the policy label `S:A,B:G1`

```
SELECT label_to_char (hr_label) AS label,ename FROM emp
WHERE hr_label = char_to_label ('HR', 'S:A,B:G1');
```

This statement returns the following:

LABEL	ENAME
-----	-----
S:A,B:G1	RWRIGHT
S:A,B:G1	ESTANTON

Alternatively, you could use a more flexible statement to look up data that contains the string "S:A,B:G1" anywhere in the text of the `HR_LABEL` column:

```
SELECT label_to_char (hr_label) AS label,ename FROM emp
WHERE label_to_char (hr_label) like '%S:A,B:G1%';
```

If you do not use the `LABEL_TO_CHAR` function, then you will see the label tag.

Example: Retrieving a Numeric Column Data Type

The following example is with the numeric column data type (`NUMBER`) and dynamically generated label tags, but without using the `LABEL_TO_CHAR` function. If you do not use the `LABEL_TO_CHAR` function, then you will see the label tag.

```
SQL> select empno, hr_label from emp
      where ename='RWRIGHT';
```

EMPNO	HR_LABEL
-------	----------

```
-----
7839      1000000562
```

6.5.2.3 Retrieving All Columns from a Table When the Policy Label Column Is Hidden

If the policy label column is hidden, then it is not automatically returned when you run `SELECT *` on the table.

- To explicitly specify that you want to retrieve a label, use the `LABEL_TO_CHAR` function in the `SELECT` statement.

For example, to retrieve all columns from the `DEPT` table (including the policy label column in its character representation), enter the following:

```
COLUMN LABEL FORMAT a10
SELECT LABEL_TO_CHAR (hr_label) AS LABEL, DEPT.* FROM DEPT;
```

Running these SQL statements returns the following data:

Table 6-3 Data Returned from Sample SQL Statements re Hidden Column

LABEL	DEPTNO	DNAME	LOC
L1	10	ACCOUNTING	NEW YORK
L1	20	RESEARCH	DALLAS
L1	30	SALES	CHICAGO
L1	40	OPERATIONS	BOSTON

By contrast, if you do not explicitly specify the `HR_LABEL` column, the label is not displayed at all. Note that while the policy column name is on a policy basis, the `HIDE` option is on a table-by-table basis.

Related Topics

- [How the HIDE Policy Column Option Works](#)
You can specify the `HIDE` policy configuration option when you add an Oracle Label Security policy column to a table.

6.6 Filtration of Data Using Labels

When SQL statements are processed, Oracle Label Security makes calls to the security policies defined in the database by create-and-apply procedures.

For `SELECT` statements, the policy filters the data rows that the user is authorized to see. For `INSERT`, `UPDATE`, and `DELETE` statements, Oracle Label Security permits or denies the requested operation, based on the user's authorizations.

- [Use of Numeric Label Tags in WHERE Clauses](#)
There are different techniques of using numeric label tags in `WHERE` clauses of `SELECT` statements.
- [Ordering Labeled Data Rows](#)
The `ORDER BY` clause of a `SELECT` statement can be used to order rows by the numeric label tag.
- [Ordering by Character Representation of Label](#)
The `LABEL_TO_CHAR` function orders data rows by the character representation of the label.

- [Determination of the Upper and Lower Bounds of Labels](#)
Oracle Label Security provides functions that determine the least upper bound or the greatest lower bound of two or more labels.
- [Merging Labels with the MERGE_LABEL Function](#)
The `MERGE_LABEL` function merges two labels together.

6.6.1 Use of Numeric Label Tags in WHERE Clauses

There are different techniques of using numeric label tags in `WHERE` clauses of `SELECT` statements.

When using labels in the `NUMBER` format, you can set up labels so that a list of your label tags distinguishes the different levels. Comparisons of these numeric label tags can be used for `ORDER BY` processing, and with the logical operators.

For example, if you have assigned all `UNCLASSIFIED` labels to the 1000 range, all `SENSITIVE` labels to the 2000 range, and all `HIGHLY_SENSITIVE` labels to the 3000 range, then you can list all `SENSITIVE` records.

```
SELECT * FROM emp
WHERE hr_label BETWEEN 2000 AND 2999;
```

To list all `SENSITIVE` and `UNCLASSIFIED` records, you can enter:

```
SELECT * FROM emp
WHERE hr_label <3000;
```

To list all `HIGHLY_SENSITIVE` records, you can enter:

```
SELECT * FROM emp
WHERE hr_label=3000;
```

Note:

Remember that such queries have meaning only if the administrator has applied a numeric ordering strategy to the label tags that they originally assigned to the labels. In this way, the administrator can provide for convenient dissemination of data. If, however, the label tag values are generated automatically, then there is no intrinsic relationship between the value of the tag and the order of the labels.

Alternatively, you can use dominance relationships to set up an ordering strategy.

Related Topics

- [Using Dominance Functions](#)
Oracle Label Security provides functions to control dominance.

6.6.2 Ordering Labeled Data Rows

The `ORDER BY` clause of a `SELECT` statement can be used to order rows by the numeric label tag.

- To perform the `ORDER BY` operation, use a `SELECT` statement similar to the following:

```
SELECT * from emp
ORDER BY hr_label;
```

No functions were necessary in this statement. The statement made use of label tags set up by the administrator.

 **Note:**

Again, such queries have meaning only if the administrator has applied a numeric ordering strategy to the label tags originally assigned to the labels.

6.6.3 Ordering by Character Representation of Label

The `LABEL_TO_CHAR` function orders data rows by the character representation of the label.

- To order data rows by the character representation of a label, use a statement similar to the following, which returns all rows sorted by the text order of the label:

```
SELECT * FROM emp
ORDER BY label_to_char (hr_label);
```

6.6.4 Determination of the Upper and Lower Bounds of Labels

Oracle Label Security provides functions that determine the least upper bound or the greatest lower bound of two or more labels.

Two single-row functions operate on each row returned by a query. They return one result for each row.

 **Note:**

In all functions that take multiple labels, the labels must all belong to the same policy.

- Finding the Least Upper Bound with `OLS_LEAST_UBOUND`**
The `OLS_LEAST_UBOUND (OLS_LUBD)` function returns a character string label that is the least upper bound of *label1* and *label2*..
- Finding Greatest Lower Bound with `OLS_GREATEST_LBOUND`**
The `OLS_GREATEST_LBOUND (OLS_GLBD)` standalone function determines the lowest label of the data that can be involved in an operation, given two different labels.

6.6.4.1 Finding the Least Upper Bound with `OLS_LEAST_UBOUND`

The `OLS_LEAST_UBOUND (OLS_LUBD)` function returns a character string label that is the least upper bound of *label1* and *label2*..

That is, the one label that dominates both. The least upper bound is the highest level, the union of the compartments in the labels, and the union of the groups in the labels. For example, the least upper bound of `HIGHLY_SENSITIVE:ALPHA` and `SENSITIVE:BETA` is `HIGHLY_SENSITIVE:ALPHA,BETA`.

- To find the least upper bound, use the following syntax:

```
FUNCTION OLS_LEAST_UBOUND (
    label1          IN NUMBER,
```



```

label2                                IN NUMBER)
RETURN VARCHAR2;

```

The `OLS_LEAST_UBOUND` function is useful when joining rows with different labels, because it provides a high water mark label for joined rows.

The following query compares each employee's label with the label of their department, and returns the higher label, whether it be in the EMP table or the DEPT table.

```

SELECT ename,dept.deptno,
       OLS_LEAST_UBOUND(emp.hr_label,dept.hr_label) as label
FROM emp, dept
WHERE emp.deptno=dept.deptno;

```

This query returns the following data:

Table 6-4 Data Returned from Sample SQL Statements from OLS_LEAST_UBOUND

ENAME	DEPTNO	LABEL
KING	10	L3:M:D10
BLAKE	30	L3:M:D30
CLARK	10	L3:M:D10
JONES	20	L3:M:D20
MARTIN	30	L2:E:D30

6.6.4.2 Finding Greatest Lower Bound with OLS_GREATEST_LBOUND

The `OLS_GREATEST_LBOUND` (`OLS_GLBD`) standalone function determines the lowest label of the data that can be involved in an operation, given two different labels.

This function returns a character string label that is the greatest lower bound of *label1* and *label2*. The greatest lower bound is the lowest level, the intersection of the compartments in the labels and the groups in the labels. For example, the greatest lower bound of `HIGHLY_SENSITIVE:ALPHA` and `SENSITIVE` is `SENSITIVE`.

- To find the greatest lower bound, use the following syntax:

```

FUNCTION OLS_GREATEST_LBOUND (
    label1                                IN NUMBER,
    label2                                IN NUMBER)
RETURN VARCHAR2;

```

6.6.5 Merging Labels with the MERGE_LABEL Function

The `MERGE_LABEL` function merges two labels together.

It accepts the numeric form of two labels and the three-character specification of a merge format.

- To merge labels, use the following syntax:

```

FUNCTION merge_label (label1 IN number,
                    label2 IN number,
                    merge_format IN VARCHAR2)
RETURN number;

```

The valid merge format is specified with a three-character string:

*highest_level_or_lowest_level union_or_intersection_of_compartments
union_or_intersection_of_groups*

- The first character indicates whether to merge using the highest level or the lowest level of the two labels.
- The second character indicates whether to merge using the union or the intersection of the compartments in the two labels.
- The third character indicates whether to merge using the union or the intersection of the groups in the two labels.

Table 6-5 defines the MERGE_LABEL format constants.

Table 6-5 MERGE_LABEL Format Constants

Format Specification	Data Type	Constant	Meaning	Positions in Which Format Is Used
max_lvl_fmt	CONSTANT varchar2(1)	H	Maximum level	First (level)
min_lvl_fmt	CONSTANT varchar2(1)	L	Minimum level	First (Level)
union_fmt	CONSTANT varchar2(1)	U	Union of the two labels	Second (compartments) and Third (groups)
inter_fmt	CONSTANT varchar2(1)	I	Intersection of the two labels	Second (compartments) and Third (groups)
minus_fmt	CONSTANT varchar2(1)	M	Remove second label from first label	Second (compartments) and Third (groups)
null_fmt	CONSTANT varchar2(1)	N	If specified in compartments column, returns no compartments. If specified in groups column, returns no groups.	Second (compartments) and Third (groups)

For example, HUI specifies the highest level of the two labels, union of the compartments, intersection of the groups.

The MERGE_LABEL function is particularly useful to developers if the OLS_LEAST_UBOUND function does not provide the intended result. The OLS_LEAST_UBOUND function, when used with two labels containing groups, may result in a less sensitive data label than expected. The MERGE_LABEL function enables you to compute an intersection on the groups, instead of the union of groups that is provided by the OLS_LEAST_UBOUND function.

For example, if the label of one data record contains the group UNITED_STATES, and the label of another data record contains the group UNITED_KINGDOM, and the OLS_LEAST_UBOUND function is used to compute the least upper bound of these two labels, then the resulting label would be accessible to users authorized for either the UNITED_STATES or the UNITED_KINGDOM.

If, by contrast, the `MERGE_LABEL` function is used with a format clause of `HUI`, then the resulting label would contain the highest level, the union of the compartments, and no groups. This is because `UNITED_STATES` and `UNITED_KINGDOM` do not intersect.

6.7 Inserting Labeled Data

You can insert labeled data in a variety of situations.

- [About Inserting Labeled Data](#)
When you insert data into a table protected by an Oracle Label Security policy, you must supply a numeric label value tag.
- [Inserting Labels Using CHAR_TO_LABEL](#)
To insert a row label, you can specify the label character string and then transform it into a label using the `CHAR_TO_LABEL` function.
- [Inserting Labels Using Numeric Label Tag Values](#)
You can insert data using the numeric label tag value of a label, rather than using the `CHAR_TO_LABEL` function.
- [Inserting Data Without Specifying a Label](#)
There are two situations in which you do not need to specify a label in `INSERT` statements.
- [Inserting Data When the Policy Label Column Is Hidden](#)
If the label column is hidden, then the existence of the column is transparent to the insertion of data.
- [Inserting Labels Using TO_DATA_LABEL](#)
The `TO_DATA_LABEL` function can generate new labels dynamically.

6.7.1 About Inserting Labeled Data

When you insert data into a table protected by an Oracle Label Security policy, you must supply a numeric label value tag.

Usually, you can insert this value in the `INSERT` statement itself.

To do this, you must explicitly specify the tag for the desired label or explicitly convert the character string representation of the label into the correct tag. Note that this does not mean generating new label tags, but referencing the correct tag.

The only times an `INSERT` statement may omit a label value are:

- If the `LABEL_DEFAULT` enforcement option was specified when the policy was applied, or
- If no enforcement options were specified when the policy was applied and `LABEL_DEFAULT` was specified when the policy was created
- If the statement applying the policy named a labeling function.

In the first two cases, the user's session default row label is used as the inserted row's label. In the third case, the inserted row's label is created by that labeling function.

Related Topics

- [Labeling Functions](#)
Labeling functions can compute and return a label using resources such as context variables (for example, date or username) and data values.

- [Implementing Policy Enforcement Options and Labeling Functions](#)
You can customize the enforcement of Oracle Label Security policies and implement labeling functions.

6.7.2 Inserting Labels Using CHAR_TO_LABEL

To insert a row label, you can specify the label character string and then transform it into a label using the `CHAR_TO_LABEL` function.

The `CHAR_TO_LABEL` function automatically creates a valid data label.

- To insert labels, use an `INSERT INTO` statement.

Using the definition for table `emp`, the following example shows how to insert data with explicit labels:

```
INSERT INTO emp (ename, empno, hr_label)
VALUES ('ESTANTON', 10, char_to_label ('HR', 'SENSITIVE'));
```

6.7.3 Inserting Labels Using Numeric Label Tag Values

You can insert data using the numeric label tag value of a label, rather than using the `CHAR_TO_LABEL` function.

- To insert labels using numeric label tag values, use an `INSERT INTO` statement.

For example, if the numeric label tag for `SENSITIVE` is 3000, it would appear as follows:

```
INSERT INTO emp (ename, empno, hr_label)
VALUES ('ESTANTON', 10, 3000);
```

6.7.4 Inserting Data Without Specifying a Label

There are two situations in which you do not need to specify a label in `INSERT` statements.

If `LABEL_DEFAULT` is set, or if there is a labeling function applied to the table, then you do not need to specify a label in your `INSERT` statements. The label will be provided automatically.

- To insert data without specifying a label, use an `INSERT INTO` statement.

For example:

```
INSERT INTO emp (ename, empno)
VALUES ('ESTANTON', 10);
```

The resulting row label is set according to the default value (or by a labeling function).

6.7.5 Inserting Data When the Policy Label Column Is Hidden

If the label column is hidden, then the existence of the column is transparent to the insertion of data.

`INSERT` statements can be written that do not explicitly list the table columns and do not include a value for the label column. The session's row label is used to label the data, or a labeling function is used if one was specified when the policy was applied to the table or schema. You can insert into a table without explicitly naming the columns, as long as you specify a value for each non-hidden column in the table. The following example shows how to insert a row into a table.

- To insert data when the policy label column is hidden, use the following syntax:

```
INSERT INTO emp  
VALUES ('196', 'ESTANTON', Technician, RSTOUT, 50000, 10);
```

Its label will be one of the following three possibilities:

- The label you specify
- The label established by the `LABEL_DEFAULT` option of the policy being applied
- The label created by a labeling function named by the policy being applied

 **Note:**

If the policy label column is *not* hidden, then you must explicitly include a label value (possibly null, indicated by a comma) in the `INSERT` statement.

6.7.6 Inserting Labels Using `TO_DATA_LABEL`

The `TO_DATA_LABEL` function can generate new labels dynamically.

This approach guarantees that the data labels are valid.

1. Ensure that you have the `EXECUTE` privilege on the `TO_DATA_LABEL` function.
2. Use the `TO_DATA_LABEL` as necessary, for example, in an `INSERT INTO` statement.

For example:

```
INSERT INTO emp (ename, empno, hr_label)  
VALUES ('ESTANTON', 10, to_data_label ('HR', 'SENSITIVE'));
```

 **Note:**

The `TO_DATA_LABEL` function must be explicitly granted to individuals, in order to be used. Its usage should be tightly controlled.

6.8 Changing Session and Row Labels

During a session, a user can change labels based on the authorizations an administrator sets.

Related Topics

- [SA_SESSION Session Management PL/SQL Package](#)
The `SA_SESSION` PL/SQL package manages session behavior for user authorizations.

Part III

Oracle Label Security Tutorials

Part III provides tutorials on how to create Oracle Label Security policies.

- [Tutorial: Configuring Levels in Oracle Label Security](#)
This tutorial demonstrates how to create Oracle Label Security levels.
- [Tutorial: Configuring Compartments in Oracle Label Security](#)
This tutorial demonstrates how to create and use Oracle Label Security compartments.
- [Tutorial: Configuring Groups in Oracle Label Security](#)
This tutorial demonstrates how to create an Oracle Label Security parent group that has four child groups.

7

Tutorial: Configuring Levels in Oracle Label Security

This tutorial demonstrates how to create Oracle Label Security levels.

- [About This Tutorial](#)
In this tutorial, you will use the `HR` schema to learn how to use Oracle Label Security levels.
- [Step 1: Create a Role and User Accounts](#)
The role that you create will enable any user who is granted it to have the `SELECT` privilege on the `HR.EMPLOYEES` table. The user accounts are for the two Human Resources employees, Susan Mavris and Ida Neau.
- [Step 2: Create the Oracle Label Security Policy Container](#)
As an Oracle Label Security administrator, you must create and then enable the policy container.
- [Step 3: Create the Two Level Components for the Oracle Label Security Policy](#)
After you create the Oracle Label Security policy container, you are ready to create two levels to represent two different levels of sensitivity.
- [Step 4: Create the Data Labels for the Levels](#)
A data label tags data records for use with the Oracle Label Security policy.
- [Step 5: Set User Authorizations for the Oracle Label Security Policy](#)
Setting user authorizations entails associating the user with the policy and the minimum and maximum levels that are associated with the Oracle Label Security policy.
- [Step 6: Apply the Oracle Label Security Policy to the HR Schema](#)
After you apply the policy to the `HR` schema, you must enable the policy association with `HR`.
- [Step 7: Add the Policy Labels to the HR.EMPLOYEES Table Data](#)
Both the Oracle Label Security administrator and the `HR` user will add the policy labels to the `HR.EMPLOYEES` table data in the `EMPLOYEE_ID` column.
- [Step 8: Test the Oracle Label Security Policy](#)
To test the policy, each user will try to query the `HR.EMPLOYEES` table.
- [Step 9: Optionally, Remove the Oracle Label Security Policy Components](#)
You can remove the Oracle Label Security policy, `HR_ROLE` role, and users Ida Neau and Susan Mavris.

7.1 About This Tutorial

In this tutorial, you will use the `HR` schema to learn how to use Oracle Label Security levels.

The Human Resources representative, Susan Mavris, has an assistant, Ida Neau. Susan Mavris must have access to all employee records, including records of employees who have left the company. Ida Neau must have access only to employees who are current.

You will create an Oracle Label Security policy that will use the following levels of sensitivity to govern access to current and former employees:

- `SENSITIVE` enables access to current employees only. User Ida Neau will be assigned this level.
- `HIGHLY_SENSITIVE` enables access to former employees. User Susan Mavris will be assigned this level. This level is a higher level than `SENSITIVE`, which means that it will also provide access to rows protected by `SENSITIVE`. In other words, Susan Mavris will have access to both former and current employee records.

The level component is the only one required. The label must specify at least one level.

7.2 Step 1: Create a Role and User Accounts

The role that you create will enable any user who is granted it to have the `SELECT` privilege on the `HR.EMPLOYEES` table. The user accounts are for the two Human Resources employees, Susan Mavris and Ida Neau.

1. Log in to a PDB as a user who has privileges to create roles, grant privileges, and create user accounts.

For example:

```
sqlplus sec_admin@pdb_name  
Enter password: password
```

To find the available PDBs, query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.

2. Create the role as follows:

```
CREATE ROLE HR_ROLE;
```

3. Grant the `SELECT` privilege on `HR.EMPLOYEES` to `HR_ROLE`.

```
GRANT SELECT ON HR.EMPLOYEES TO HR_ROLE;
```

4. Create the user accounts for Susan Mavris and Ida Neau, and grant them the `HR_ROLE` role.

```
GRANT CONNECT, HR_ROLE TO SMAVRIS IDENTIFIED BY password;  
GRANT CONNECT, HR_ROLE TO INEAU IDENTIFIED BY password;
```

7.3 Step 2: Create the Oracle Label Security Policy Container

As an Oracle Label Security administrator, you must create and then enable the policy container.

1. Connect to the PDB as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name  
Enter password: password
```

2. Create the policy.

```
BEGIN  
  SA_SYSDBA.CREATE_POLICY (  
    policy_name      => 'HR_OLS_POL',  
    column_name      => 'OLS_COL');  
END;  
/
```


In this specification, the `default_options` parameter is omitted because you can add it later on in another procedure.

After you create this policy container, Oracle Label Security creates and grants a role to you named `HR_OLS_POL_DBA`, which enables you to manage this policy during its lifetime.

3. Enable the policy.

```
EXEC SA_SYSDBA.ENABLE_POLICY ('HR_OLS_POL');
```

7.4 Step 3: Create the Two Level Components for the Oracle Label Security Policy

After you create the Oracle Label Security policy container, you are ready to create two levels to represent two different levels of sensitivity.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Create the levels as follows:

```
BEGIN
  SA_COMPONENTS.CREATE_LEVEL (
    policy_name => 'HR_OLS_POL',
    level_num   => 3000,
    short_name  => 'HS',
    long_name   => 'HIGHLY_SENSITIVE');

  SA_COMPONENTS.CREATE_LEVEL (
    policy_name => 'HR_OLS_POL',
    level_num   => 2000,
    short_name  => 'S',
    long_name   => 'SENSITIVE');
END;
/
```

In this specification:

- `policy_name` associates the levels with the policy container that you just created.
- `level_num` determines how much access the user can have. Level number 3000 enables a user to have access to this level and any level number below it, in this case, level number 2000. In other words, a user who is authorized with the `HIGHLY_SENSITIVE` level can also access data assigned to the `SENSITIVE` level.
- `short_name` is a short-hand name for the `long_name` of the level, and will be used in other procedures to refer to the `long_name` version of the level.

7.5 Step 4: Create the Data Labels for the Levels

A data label tags data records for use with the Oracle Label Security policy.

In this procedure, the data labels will designate the rows that users Susan Mavris and Ida Neau will see in the `HR.EMPLOYEES` table. The rows labeled `HS` will correspond to the `HS`

(HIGHLY_SENSITIVE) level to be assigned to Susan Mavris, and the rows labeled S will correspond with the S (SENSITIVE) level to be assigned to Ida Neau.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Create the data labels as follows:

```
BEGIN
  SA_LABEL_ADMIN.CREATE_LABEL (
    policy_name => 'HR_OLS_POL',
    label_tag   => 3100,
    label_value => 'HS',
    data_label  => TRUE);

  SA_LABEL_ADMIN.CREATE_LABEL (
    policy_name => 'HR_OLS_POL',
    label_tag   => 2100,
    label_value => 'S',
    data_label  => TRUE);
END;
/
```

In this specification:

- `label_tag` is used internally by Oracle Label Security to identify the level. Unlike levels, it does not govern any sort of hierarchy with the labels.
- `data_label` is set to `TRUE` so that the label can be applied to row data.

7.6 Step 5: Set User Authorizations for the Oracle Label Security Policy

Setting user authorizations entails associating the user with the policy and the minimum and maximum levels that are associated with the Oracle Label Security policy.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Authorize the users as follows:

```
BEGIN
  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'HR_OLS_POL',
    user_name   => 'SMAVRIS',
    max_level   => 'HS',
    min_level   => 'S');

  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'HR_OLS_POL',
    user_name   => 'INEAU',
    max_level   => 'S',
    min_level   => 'S');
```

```

        min_level    => 'S');
END;
/

```

In this specification, the `def_level` (default level) and `row_level` parameters are omitted so that their values can default to the `max_level` parameter setting.

7.7 Step 6: Apply the Oracle Label Security Policy to the HR Schema

After you apply the policy to the HR schema, you must enable the policy association with HR.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```

sqlplus psmith_ols@pdb_name
Enter password: password

```

2. Apply the policy to the HR schema.

```

BEGIN
  SA_POLICY_ADMIN.APPLY_TABLE_POLICY (
    policy_name    => 'HR_OLS_POL',
    schema_name    => 'HR',
    table_name     => 'EMPLOYEES',
    table_options  => 'READ_CONTROL');
END;
/

```

Earlier, when you created the policy with the `SA_SYSDBA.CREATE_POLICY` procedure, you did not set the `default_options` parameter, which defines the policy enforcement options. Therefore, you must set the policy enforcement here, with the `table_options` parameter of `SA_POLICY_ADMIN.APPLY_TABLE_POLICY`. `READ_CONTROL` enforces the OLS policy during the `SELECT` statement processing that the users will perform later. (It also applies to `UPDATE` and `DELETE` statement processing.)

3. Enable the policy's association with the HR schema.

```

BEGIN
  SA_POLICY_ADMIN.ENABLE_TABLE_POLICY (
    policy_name => 'HR_OLS_POL',
    schema_name => 'HR',
    table_name  => 'EMPLOYEES');
END;
/

```

7.8 Step 7: Add the Policy Labels to the HR.EMPLOYEES Table Data

Both the Oracle Label Security administrator and the HR user will add the policy labels to the HR.EMPLOYEES table data in the `EMPLOYEE_ID` column.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Grant the READ privilege to the HR_OLS_POL policy for the HR user.

```
BEGIN
  SA_USER_ADMIN.SET_USER_PRIVS (
    policy_name => 'HR_OLS_POL',
    user_name   => 'HR',
    privileges  => 'READ');
END;
/
```

3. Connect as the HR user.

```
connect hr
Enter password: password
```

4. Perform the following UPDATE statement to apply the HIGHLY_SENSITIVE level to the employee IDs of users who have left the company.

This UPDATE statement controls the access that Susan Mavris will have to the HR.EMPLOYEES table because this user is authorized for the HIGHLY_SENSITIVE level.

```
UPDATE employees
SET   ols_col = CHAR_TO_LABEL('HR_OLS_POL','HS')
WHERE UPPER(employee_id) IN (200, 101, 102, 176, 201, 122, 114);
```

5. Perform the following UPDATE statement to apply the SENSITIVE level to the employee IDs of current employees in the company.

This UPDATE statement controls the access that Ida Neau will have to the HR.EMPLOYEES table because this user is authorized for the SENSITIVE level.

This also controls what Susan Marvris will have since Susan will be able to see SENSITIVE and HIGHLY_SENSITIVE level data.

```
UPDATE employees
SET   ols_col = CHAR_TO_LABEL('HR_OLS_POL','S')
WHERE UPPER(employee_id) NOT IN (200, 101, 102, 176, 201, 122, 114);
```

This UPDATE statement translates to "Apply the SENSITIVE label to any employee who is not a former employee."

7.9 Step 8: Test the Oracle Label Security Policy

To test the policy, each user will try to query the HR.EMPLOYEES table.

1. Connect as user Ida Neau.

```
connect ineau@pdb_name
Enter password: password
```

2. Set column widths for the table output.

```
column first_name format a25
column last_name  format a25
column ols_label  format a10
```

3. Run the following query:

```
SELECT FIRST_NAME, LAST_NAME, EMPLOYEE_ID,
       LABEL_TO_CHAR(OLS_COL) OLS_LABEL
FROM   HR.EMPLOYEES
ORDER BY OLS_COL;
```

The output should be similar to the following:

FIRST_NAME	LAST_NAME	EMPLOYEE_ID	OLS_LABEL
Steven	King	100	S
Alexander	Hunold	103	S
Bruce	Ernst	104	S
David	Austin	105	S
Valli	Pataballa	106	S
Diana	Lorentz	107	S
Nancy	Greenberg	108	S
Daniel	Faviet	109	S
...			

100 rows selected

Because Ida Neau was assigned the `SENSITIVE` label, the output in the column `OLS_LABEL` is `S` (for `SENSITIVE`) only. 100 rows are returned.

Note that the Oracle Label Security restriction applies to any `SELECT` query the user makes. For example, if Ida Neau performs a `SELECT COUNT(*) FROM HR.EMPLOYEES;` query, then it would return these 100 rows, not the full 107.

4. Connect as user Susan Mavris.

```
connect smavris
Enter password: password
```

5. Run the same query that Ida Neau ran.

```
SELECT FIRST_NAME, LAST_NAME, EMPLOYEE_ID,
       LABEL_TO_CHAR(OLS_COL) OLS_LABEL
FROM HR.EMPLOYEES
ORDER BY OLS_COL;
```

The output should be similar to the following:

FIRST_NAME	LAST_NAME	EMPLOYEE_ID	OLS_LABEL
Steven	King	100	S
Alexander	Hunold	103	S
...			
William	Gietz	206	S
Neena	Kochhar	101	HS
Lex	De Haan	102	HS
Den	Raphaely	114	HS
Michael	Hartstein	201	HS
Jonathon	Taylor	176	HS
Jennifer	Whalen	200	HS
Payam	Kaufling	122	HS

107 rows selected

Because Susan Mavris was assigned the `HIGHLY_SENSITIVE` label, the output in the column `OLS_LABEL` is `HS` (for `HIGHLY_SENSITIVE`) and `S` (for `SENSITIVE`). 107 rows are returned.

7.10 Step 9: Optionally, Remove the Oracle Label Security Policy Components

You can remove the Oracle Label Security policy, `HR_ROLE` role, and users `Ida Neau` and `Susan Mavris`.

However, if you want to try the tutorial on how to create Oracle Label Security compartments, then do not remove these components. The tutorial on compartments builds on this tutorial on levels.

1. Connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name  
Enter password: password
```

2. Drop the Oracle Label Security policy.

This procedure also removes the levels and the `OLS_COL` column from the `HR.EMPLOYEES` table.

```
BEGIN  
  SA_SYSDBA.DROP_POLICY (  
    policy_name => 'HR_OLS_POL',  
    drop_column => TRUE);  
END;  
/
```

3. Connect as user who has privileges to drop roles and user accounts.

For example:

```
connect sec_admin@pdb_name  
Enter password: password
```

4. Drop the `HR_ROLE` role.

```
DROP ROLE HR_ROLE;
```

5. Drop the `ineau` and `smavris` accounts.

```
DROP USER INEAU;  
DROP USER SMAVRIS;
```

Related Topics

- [Tutorial: Configuring Compartments in Oracle Label Security](#)
This tutorial demonstrates how to create and use Oracle Label Security compartments.

8

Tutorial: Configuring Compartments in Oracle Label Security

This tutorial demonstrates how to create and use Oracle Label Security compartments.

- [About This Tutorial](#)
In this tutorial, you will use the `HR` schema to learn how to use Oracle Label Security compartments.
- [Step 1: Create an Account for Lily Leagull](#)
Lily Leagull will initially have the same privileges as Susan Mavris and Ida Neau.
- [Step 2: Authorize Lily Leagull for the HIGHLY_SENSITIVE Level](#)
After the `l1eagull` account has been created, you can authorize it to use the `HIGHLY_SENSITIVE` level.
- [Step 3: Create Two Compartments for the Oracle Label Security Policy](#)
All three users (Susan Mavris, Ida Neau, and Lily Leagull) will use compartments to access their data.
- [Step 4: Create the Data Labels for the Compartments](#)
You will create three data labels for the compartments.
- [Step 5: Assign the Labels to the Users](#)
Assigning the labels to the users will designate the rows to which these users will have access.
- [Step 6: Add the Policy Labels to the HR.EMPLOYEES Table Data](#)
The `HR` user will add the policy labels to the `HR.EMPLOYEES` table data in the `EMPLOYEE_ID` column.
- [Step 7: Test the Oracle Label Security Policy](#)
To test the policy, each user will try to query the `HR.EMPLOYEES` table.
- [Step 8: Optionally, Remove the Oracle Label Security Policy Components](#)
You can remove the Oracle Label Security policy, `HR_ROLE` role, and users Ida Neau, Susan Mavris, and Lily Leagull.

8.1 About This Tutorial

In this tutorial, you will use the `HR` schema to learn how to use Oracle Label Security compartments.

This tutorial builds on the previous tutorial, which demonstrates how to create Oracle Label Security levels to control the access that two users, Susan Mavris and Ida Neau, have to the records in the `HR.EMPLOYEES` schema. For this tutorial, a third user, Lily Leagull, is an attorney with the company's legal department. Two former employees are suing the company, and Lily must have access to their records. This user must not have access to any other records. The access to the former users is set by the `HIGHLY_SENSITIVE` level, which you created in the previous tutorial. Access to the records of the two suing former employees will be possible through the use of a compartment within the `HIGHLY_SENSITIVE` data set, called `LEGAL`.

Related Topics

- [Tutorial: Configuring Levels in Oracle Label Security](#)
This tutorial demonstrates how to create Oracle Label Security levels.

8.2 Step 1: Create an Account for Lily Leagull

Lily Leagull will initially have the same privileges as Susan Mavris and Ida Neau.

1. Log in to a PDB as a user who has privileges to create user accounts and grant them roles.

For example:

```
sqlplus sec_admin@pdb_name  
Enter password: password
```

To find the available PDBs, query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.

2. Create the account for Lily Leagull and grant this user the `HR_ROLE` role as follows:

```
GRANT CONNECT, HR_ROLE TO LLEAGULL IDENTIFIED BY password;
```

8.3 Step 2: Authorize Lily Leagull for the HIGHLY_SENSITIVE Level

After the `lleagull` account has been created, you can authorize it to use the `HIGHLY_SENSITIVE` level.

1. Connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name  
Enter password: password
```

2. Authorize `lleagull` to use the `HIGHLY_SENSITIVE` level.

The short name for `HIGHLY_SENSITIVE` is `HS`.

```
BEGIN  
  SA_USER_ADMIN.SET_LEVELS (  
    policy_name => 'HR_OLS_POL',  
    user_name   => 'LLEAGULL',  
    max_level   => 'HS',  
    min_level   => 'S');  
END;  
/
```

8.4 Step 3: Create Two Compartments for the Oracle Label Security Policy

All three users (Susan Mavris, Ida Neau, and Lily Leagull) will use compartments to access their data.

The two HR employees, Susan Mavris and Ida Neau, will use the `HR` compartment. The Legal department employee, Lily Leagull, will use the `LEGAL (LEG)` compartment.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Create the compartments as follows:

```
BEGIN
  SA_COMPONENTS.CREATE_COMPARTMENT (
    policy_name    => 'HR_OLS_POL',
    long_name      => 'HR',
    short_name     => 'HR',
    comp_num       => 1000);

  SA_COMPONENTS.CREATE_COMPARTMENT (
    policy_name    => 'HR_OLS_POL',
    long_name      => 'LEGAL',
    short_name     => 'LEG',
    comp_num       => 2000);
END;
/
```

In this specification, the `comp_num` does not denote hierarchy as the `level_num` setting does with levels. It is only used to help identify the compartment.

8.5 Step 4: Create the Data Labels for the Compartments

You will create three data labels for the compartments.

In this procedure, the data labels will designate the rows that users Susan Mavris, Ida Neau, and Lily Leagull will see in the `HR.EMPLOYEES` table.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Create the data labels as follows:

```
BEGIN
  SA_LABEL_ADMIN.CREATE_LABEL (
    policy_name    => 'HR_OLS_POL',
    label_tag      => 1100,
    label_value    => 'S:HR:', -- SENSITIVE level for the HR compartment
    data_label     => TRUE);

  SA_LABEL_ADMIN.CREATE_LABEL (
    policy_name    => 'HR_OLS_POL',
    label_tag      => 1200,
    label_value    => 'HS:HR:', -- HIGHLY_SENSITIVE level for the HR compartment
    data_label     => TRUE);

  SA_LABEL_ADMIN.CREATE_LABEL (
    policy_name    => 'HR_OLS_POL',
    label_tag      => 1300,
    label_value    => 'HS:LEG:', --HIGHLY_SENSITIVE level for the LEG compartment
    data_label     => TRUE);
```

```
END;  
/
```

In this specification:

- `label_value S:HR` will be assigned to the records of all current employees.
- `label_value HS:HR` will be assigned to the records all current and former employees.
- `label_value HS:LEG` will be assigned to the records of former employees who are suing the company.

8.6 Step 5: Assign the Labels to the Users

Assigning the labels to the users will designate the rows to which these users will have access.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name  
Enter password: password
```

2. Assign the labels to the users as follows:

```
BEGIN  
  SA_USER_ADMIN.SET_USER_LABELS (  
    policy_name  => 'HR_OLS_POL',  
    user_name    => 'ineau',  
    max_read_label => 'S:HR:');  
  
  SA_USER_ADMIN.SET_USER_LABELS (  
    policy_name  => 'HR_OLS_POL',  
    user_name    => 'smavris',  
    max_read_label => 'HS:HR,LEG:');  
  
  SA_USER_ADMIN.SET_USER_LABELS (  
    policy_name  => 'HR_OLS_POL',  
    user_name    => 'lleagull',  
    max_read_label => 'HS:LEG:');  
END;  
/
```

In this specification:

- User `ineau` (Ida Neau), who is authorized for the `HR` compartment, will continue to have access to all current employees, but not the former or suing employees.
- User `smavris` (Susan Mavris), who is authorized for both the `HR` and `LEG` compartments, will continue to have access to all current and former employees, and former employees who are suing the company.
- User `lleagul` (Lily Leagul), who is authorized for the `LEG` compartment, will have access only to former employees who are suing the company.

8.7 Step 6: Add the Policy Labels to the HR.EMPLOYEES Table Data

The HR user will add the policy labels to the HR.EMPLOYEES table data in the EMPLOYEE_ID column.

1. Connect as the HR user.

```
connect hr@pdb_name
Enter password: password
```

2. Perform the following UPDATE statement to apply the SENSITIVE level and the HR compartment to the employee IDs of users who are still currently employed with the company.

This UPDATE statement controls the access that Ida Neau will have to the HR.EMPLOYEES table because Ida is authorized for the SENSITIVE level and the HR compartment.

```
UPDATE employees
SET   ols_col = CHAR_TO_LABEL('HR_OLS_POL','HS:HR')
WHERE UPPER(employee_id) NOT IN (200, 101, 102, 176, 201, 122, 114);
```

3. Perform the following UPDATE statement to apply the HIGHLY_SENSITIVE level and HR compartment to the employee IDs of current and former employees.

This UPDATE statement controls the access that Susan Mavris will have to the HR.EMPLOYEES table because Susan is authorized for the HIGHLY_SENSITIVE level and the HR compartment.

```
UPDATE employees
SET   ols_col = CHAR_TO_LABEL('HR_OLS_POL','HS:HR')
WHERE UPPER(employee_id) IN (200, 101, 102, 176, 201, 122, 114);
```

4. Perform the following UPDATE statement to apply the HIGHLY_SENSITIVE level and LEG compartment to the employee IDs of former employees who are suing the company.

This UPDATE statement controls the access that Lily Leagull will have to the HR.EMPLOYEES table because Lily is authorized for the HIGHLY_SENSITIVE level and the LEG compartment.

```
UPDATE employees
SET   ols_col = CHAR_TO_LABEL('HR_OLS_POL','HS:LEG')
WHERE UPPER(employee_id) IN (200, 101);
```

8.8 Step 7: Test the Oracle Label Security Policy

To test the policy, each user will try to query the HR.EMPLOYEES table.

1. Connect as user Ida Neau.

```
connect ineau@pdb_name
Enter password: password
```

2. Set column widths for the table output.

```
column first_name format a25
column last_name format a25
column ols_label format a10
```

3. Run the following query:

```
SELECT FIRST_NAME, LAST_NAME, EMPLOYEE_ID,
       LABEL_TO_CHAR(OLS_COL) OLS_LABEL
FROM HR.EMPLOYEES
ORDER BY OLS_COL;
```

The output should be similar to the following:

FIRST_NAME	LAST_NAME	EMPLOYEE_ID	OLS_LABEL
Steven	King	100	S:HR
Alexander	Hunold	103	S:HR
Bruce	Ernst	104	S:HR
David	Austin	105	S:HR
Valli	Pataballa	106	S:HR
Diana	Lorentz	107	S:HR
Nancy	Greenberg	108	S:HR
Daniel	Faviet	109	S:HR
John	Chen	110	S:HR
Ismael	Sciarra	111	S:HR
...			

100 rows selected

Because Ida Neau was assigned the SENSITIVE (S) label and the HR compartment, the output in the column OLS_LABEL is S:HR. 100 rows are returned.

Note that the Oracle Label Security policy restriction applies to any SELECT query the user makes. For example, if Ida Neau performs a SELECT COUNT(*) FROM HR.EMPLOYEES; query, then it would return 100 rows, not the full 107.

4. Connect as user Susan Mavris.

```
connect smavris
Enter password: password
```

5. Run the same query that Ida Neau ran.

```
SELECT FIRST_NAME, LAST_NAME, EMPLOYEE_ID,
       LABEL_TO_CHAR(OLS_COL) OLS_LABEL
FROM HR.EMPLOYEES
ORDER BY OLS_COL;
```

The output should be similar to the following:

FIRST_NAME	LAST_NAME	EMPLOYEE_ID	OLS_LABEL
Steven	King	100	S:HR
Alexander	Hunold	103	S:HR
Bruce	Ernst	104	S:HR
David	Austin	105	S:HR
Valli	Pataballa	106	S:HR
...			
Jennifer	Whalen	200	HS:LEG
Neena	Kochhar	101	HS:LEG
Michael	Hartstein	201	HS:HR,LEG
Jonathon	Taylor	176	HS:HR,LEG
Den	Raphaely	114	HS:HR,LEG
Lex	De Haan	102	HS:HR,LEG
Payam	Kaufling	122	HS:HR,LEG

107 rows selected

Because Susan Mavris was assigned the `HIGHLY_SENSITIVE (HS)` level with the `HR` and `LEG` compartments, the output in the column `OLS_LABEL` is as follows:

- `S:HR` to capture all current employees
- `HS:HR, LEG` to capture all former employees
- `HS:LEG` to capture former employees who are suing.

107 rows are returned.

6. Connect as user Lily Leagull.

```
connect lleagull
Enter password: password
```

7. Run the same query that Susan Mavris ran.

```
SELECT FIRST_NAME, LAST_NAME, EMPLOYEE_ID,
       LABEL_TO_CHAR(OLS_COL) OLS_LABEL
FROM HR.EMPLOYEES
ORDER BY OLS_COL;
```

The output should be similar to the following:

FIRST_NAME	LAST_NAME	EMPLOYEE_ID	OLS_LABEL
Jennifer	Whalen	200	HS:LEG
Neena	Kochhar	101	HS:LEG

107 rows selected

Because Lily Leagull was assigned the `HS` level with the `LEG` compartment, only former users who are suing are returned for this query.

8.9 Step 8: Optionally, Remove the Oracle Label Security Policy Components

You can remove the Oracle Label Security policy, `HR_ROLE` role, and users Ida Neau, Susan Mavris, and Lily Leagull.

1. Connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Drop the Oracle Label Security policy.

This procedure also removes the levels, compartments, and from the `HR.EMPLOYEES` table, the `OLS_COL` column.

```
BEGIN
  SA_SYSDBA.DROP_POLICY (
    policy_name => 'HR_OLS_POL',
    drop_column => TRUE);
END;
/
```

3. Connect as user who has privileges to drop roles and user accounts.

For example:

```
connect sec_admin@pdb_name
Enter password: password
```

4. Drop the HR_ROLE role.

```
DROP ROLE HR_ROLE;
```

5. Drop the ineau, smavris, and lleagull accounts.

```
DROP USER INEAU;
DROP USER SMAVRIS;
DROP USER LLEAGULL;
```

9

Tutorial: Configuring Groups in Oracle Label Security

This tutorial demonstrates how to create an Oracle Label Security parent group that has four child groups.

- [About This Tutorial](#)
In this tutorial, you will use the `OE` schema to learn how to use Oracle Label Security groups.
- [Step 1: Create a Role and User Accounts](#)
The role that you create will enable any user who is granted it to have the `SELECT` privilege on the `OE.CUSTOMERS` table. The user accounts are for four sales representatives and the advertising president, Steven King.
- [Step 2: Create the Oracle Label Security Policy Container](#)
As an Oracle Label Security administrator, you must create and then enable the policy container.
- [Step 3: Create and Authorize a Level Component for the Oracle Label Security Policy](#)
After you create the Oracle Label Security policy container, you are ready to create and authorize a level component.
- [Step 4: Create and Authorize Groups for the Oracle Label Security Policy](#)
You will create and authorize one parent group and four child groups for this parent group. Each user will be authorized for a group.
- [Step 5: Apply and Authorize the Policy to the Table](#)
You must apply the `OE_OLS_POL` policy to the `OE.CUSTOMERS` table and then authorize the `OE` schema user to have read privileges for the policy.
- [Step 6: Add the Policy Labels to the OE.CUSTOMERS Table Data](#)
The `OE` user will add the policy labels to the `OE.CUSTOMERS` table data in the `OLS_COL` column.
- [Step 7: Test the Oracle Label Security Policy](#)
To test the policy, each user will query the `OE.CUSTOMERS` table.
- [Step 8: Optionally, Remove the Oracle Label Security Policy Components](#)
You can remove the Oracle Label Security policy, `OE_CUST` role, and the user accounts.

9.1 About This Tutorial

In this tutorial, you will use the `OE` schema to learn how to use Oracle Label Security groups.

Each sales manager must have access to the records of their customers in the `OE.CUSTOMERS` table. The company president of advertising, Steven King, who each sales manager reports to, must have access to all customer records. The customer records are divided into groups based on the sales managers' territories.

The Oracle Label Security policy that you create will assign each of the sales managers a group, and this group will be used to label the appropriate rows in the `OE.CUSTOMERS` table. The

groups will have a parent group, `GLOBAL_SALES`, which will be associated with advertising president Steven King. The child groups of `GLOBAL_SALES` are as follows:

- `EUROPE`, with access by sales manager Alberto Errazuriz
- `ASIA`, with access by sales manager Gerald Cambrault
- `UNITED_STATES_1`, with access by sales manager John Russell
- `UNITED_STATES_2`, with access by sales manager Eleni Zlotkey

By default, the `OE` schema is not installed. You can download this schema from GitHub, as explained in *Oracle Database Sample Schemas*.

Related Topics

- *Oracle Database Sample Schemas*

9.2 Step 1: Create a Role and User Accounts

The role that you create will enable any user who is granted it to have the `SELECT` privilege on the `OE.CUSTOMERS` table. The user accounts are for four sales representatives and the advertising president, Steven King.

1. Log in to a PDB as a user who has privileges to create roles, grant privileges, and create user accounts.

For example:

```
sqlplus sec_admin@pdb_name
Enter password: password
```

To find the available PDBs, query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.

2. Ensure that the `OE` schema has been downloaded from GitHub and installed.

Oracle Database Sample Schemas explains how to download and install this schema.

3. Create the role as follows:

```
CREATE ROLE OE_CUST;
```

4. Grant the `SELECT` privilege on `OE.CUSTOMERS` to `OE_CUST`.

```
GRANT SELECT ON OE.CUSTOMERS TO OE_CUST;
```

5. Create the user accounts and grant them the `OE_CUST` role.

```
GRANT CONNECT, OE_CUST TO SKING IDENTIFIED BY password; --For Steven King, president
GRANT CONNECT, OE_CUST TO AERRAZURIZ IDENTIFIED BY password; --For Alberto
Errazuriz, sales manager
GRANT CONNECT, OE_CUST TO GCAMBRAULT IDENTIFIED BY password; --For Gerald Cambrault,
sales manager
GRANT CONNECT, OE_CUST TO JRUSSELL IDENTIFIED BY password; --For John Russell, sales
manager
GRANT CONNECT, OE_CUST TO EZLOTKEY IDENTIFIED BY password; --For Eleni Zlotkey,
sales manager
```

Related Topics

- *Oracle Database Sample Schemas*

9.3 Step 2: Create the Oracle Label Security Policy Container

As an Oracle Label Security administrator, you must create and then enable the policy container.

1. Connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Create the policy.

```
BEGIN
  SA_SYSDBA.CREATE_POLICY (
    policy_name      => 'OE_OLS_POL',
    column_name      => 'OLS_COL');
END;
/
```

In this specification, the `default_options` parameter is omitted because you can add it later on in another procedure.

After you create this policy container, Oracle Label Security creates and grants a role to you named `OE_OLS_POL_DBA`, which enables you to manage this policy during its lifetime.

3. Enable the policy.

```
EXEC SA_SYSDBA.ENABLE_POLICY ('OE_OLS_POL');
```

9.4 Step 3: Create and Authorize a Level Component for the Oracle Label Security Policy

After you create the Oracle Label Security policy container, you are ready to create and authorize a level component.

While levels are not used for this tutorial, a level is a mandatory part of a label so a single default level will be created.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Create the default level:

```
BEGIN
  SA_COMPONENTS.CREATE_LEVEL (
    policy_name => 'OE_OLS_POL',
    level_num   => 50,
    short_name  => 'D',
    long_name   => 'DEFAULT');
END;
/
```

In this specification:

- `policy_name` associates the levels with the policy container that you just created.
- `level_num` determines how much access a user can have. Level number 50 enables a user to have access to this level and any level number below it. However, this tutorial only uses one level.
- `short_name` is a short-hand name for the `long_name` of the level, and will be used in other procedures to refer to the `long_name` version of the level.

3. Authorize the level for the five users who will access the `OE.EMPLOYEES` table.

```
BEGIN
  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'OE_OLS_POL',
    user_name   => 'SKING',
    max_level   => 'D');

  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'OE_OLS_POL',
    user_name   => 'AERRAZURIZ',
    max_level   => 'D');

  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'OE_OLS_POL',
    user_name   => 'GCAMBRAULT',
    max_level   => 'D');

  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'OE_OLS_POL',
    user_name   => 'JRUSSELL',
    max_level   => 'D');

  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'OE_OLS_POL',
    user_name   => 'EZLOTKEY',
    max_level   => 'D');
END;
/
```

9.5 Step 4: Create and Authorize Groups for the Oracle Label Security Policy

You will create and authorize one parent group and four child groups for this parent group. Each user will be authorized for a group.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Create the `GLOBAL_SALES` parent group.

```
BEGIN
  SA_COMPONENTS.CREATE_GROUP (
    policy_name => 'OE_OLS_POL',
    group_num   => 2000,
    short_name  => 'GS',
    long_name   => 'GLOBAL_SALES');
END;
```

```
END;
/
```

In this specification, `group_num` is used for identification purposes only. It does not control any hierarchy in this set of groups.

3. Create the child groups.

Any user who is authorized for the parent group, `GLOBAL_SALES (GS)`, will have authorization for these child groups as well.

```
BEGIN
  SA_COMPONENTS.CREATE_GROUP (
    policy_name    => 'OE_OLS_POL',
    group_num      => 2100,
    short_name     => 'EU',
    long_name      => 'EUROPE',
    parent_name    => 'GS');

  SA_COMPONENTS.CREATE_GROUP (
    policy_name    => 'OE_OLS_POL',
    group_num      => 2200,
    short_name     => 'AS',
    long_name      => 'ASIA',
    parent_name    => 'GS');

  SA_COMPONENTS.CREATE_GROUP (
    policy_name    => 'OE_OLS_POL',
    group_num      => 2300,
    short_name     => 'US1',
    long_name      => 'UNITED_STATES_1',
    parent_name    => 'GS');

  SA_COMPONENTS.CREATE_GROUP (
    policy_name    => 'OE_OLS_POL',
    group_num      => 2400,
    short_name     => 'US2',
    long_name      => 'UNITED_STATES_2',
    parent_name    => 'GS');
END;
/
```

In this specification, the `parent_name` parameter designates the parent group, `GS`.

4. Authorize the users that you created earlier for these groups.

```
BEGIN
  SA_USER_ADMIN.SET_GROUPS (
    policy_name    => 'OE_OLS_POL',
    user_name      => 'SKING',
    read_groups    => 'GS');

  SA_USER_ADMIN.SET_GROUPS (
    policy_name    => 'OE_OLS_POL',
    user_name      => 'AERRAZURIZ',
    read_groups    => 'EU');

  SA_USER_ADMIN.SET_GROUPS (
    policy_name    => 'OE_OLS_POL',
    user_name      => 'GCAMBRAULT',
    read_groups    => 'AS');

  SA_USER_ADMIN.SET_GROUPS (
```

```

policy_name => 'OE_OLS_POL',
user_name   => 'JRUSSELL',
read_groups => 'US1');

SA_USER_ADMIN.SET_GROUPS (
  policy_name => 'OE_OLS_POL',
  user_name   => 'EZLOTKEY',
  read_groups => 'US2');
END;
/

```

In this specification, user `SKING` is authorized for the parent group, `GS`, and the remaining users, who are all sales managers, are authorized for the groups that represent their sales territories.

After you set the authorization for these groups, and because you have not yet created data labels, Oracle Label Security automatically creates the data labels for you. In earlier tutorials, you learned how to manually create the data labels, but for this tutorial, you get to allow Oracle Label Security to create them for you. You can see the labels by querying the `DBA_SA_LABELS` data dictionary view. For example:

```
SELECT POLICY_NAME, LABEL, LABEL_TAG FROM DBA_SA_LABELS ORDER BY LABEL_TAG;
```

Output similar to the following appears:

POLICY_NAME	LABEL	LABEL_TAG
OE_OLS_POL	D	1000000085
OE_OLS_POL	D::GS	1000000086
OE_OLS_POL	D::EU	1000000087
OE_OLS_POL	D::AS	1000000088
OE_OLS_POL	D::US1	1000000089
OE_OLS_POL	D::US2	1000000090

9.6 Step 5: Apply and Authorize the Policy to the Table

You must apply the `OE_OLS_POL` policy to the `OE.CUSTOMERS` table and then authorize the `OE` schema user to have read privileges for the policy.

1. If necessary, connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Apply the `OE_OLS_POL` policy to the `OE.CUSTOMERS` table.

```

BEGIN
  SA_POLICY_ADMIN.APPLY_TABLE_POLICY (
    policy_name => 'OE_OLS_POL',
    schema_name => 'OE',
    table_name  => 'CUSTOMERS',
    table_options => 'READ_CONTROL');
END;
/

```

Earlier, when you created the policy with the `SA_SYSDBA.CREATE_POLICY` procedure, you did not set the `default_options` parameter, which defines the policy enforcement options. Therefore, you must set the policy enforcement here, with the `table_options` parameter of

SA_POLICY_ADMIN.APPLY_TABLE_POLICY.READ_CONTROL enforces the OLS policy during the SELECT statement processing that the users will perform later. (It also applies to UPDATE and DELETE statement processing.)

3. Enable the OE_OLS_POL policy for OE.CUSTOMERS.

```
BEGIN
  SA_POLICY_ADMIN.ENABLE_TABLE_POLICY (
    policy_name => 'OE_OLS_POL',
    schema_name => 'OE',
    table_name  => 'CUSTOMERS');
END;
/
```

4. Set user privileges for OE so that OE can apply the labels to the OE.CUSTOMERS data rows.

```
BEGIN
  SA_USER_ADMIN.SET_USER_PRIVS (
    policy_name => 'OE_OLS_POL',
    user_name   => 'OE',
    privileges  => 'READ');
END;
/
```

9.7 Step 6: Add the Policy Labels to the OE.CUSTOMERS Table Data

The OE user will add the policy labels to the OE.CUSTOMERS table data in the OLS_COL column.

1. Connect as the OE user.

```
connect OE@pdb_name
Enter password: password
```

2. Perform the following UPDATE statement to apply the GLOBAL_SALES (GS) group to OE.CUSTOMERS.

```
UPDATE customers
SET   ols_col = CHAR_TO_LABEL('OE_OLS_POL','D::GS')
WHERE UPPER(account_mgr_id) IN (145, 147, 148, 149);
```

In this specification, the user who is authorized for the label identifier D::GS (Steven King) will have access to the rows that are available to users whose account_mgr_id IDs are 145, 147, 148, and 149.

3. Perform the following UPDATE statements for the sales managers.

For European sales manager Alberto Errazuriz, whose ID is 147:

```
UPDATE customers
SET   ols_col = CHAR_TO_LABEL('OE_OLS_POL','D::EU')
WHERE UPPER(account_mgr_id) = 147;
```

For Asian sales manager Gerald Cambraut, whose ID is 148:

```
UPDATE customers
SET   ols_col = CHAR_TO_LABEL('OE_OLS_POL','D::AS')
WHERE UPPER(account_mgr_id) = 148;
```

For US sales manager John Russell, whose ID is 145:

```
UPDATE customers
SET   ols_col = CHAR_TO_LABEL('OE_OLS_POL','D::US1')
WHERE UPPER(account_mgr_id) = 145;
```

For US sales manager Elena Zlotkey, whose ID is 149:

```
UPDATE customers
SET   ols_col = CHAR_TO_LABEL('OE_OLS_POL','D::US2')
WHERE UPPER(account_mgr_id) = 149;
```

9.8 Step 7: Test the Oracle Label Security Policy

To test the policy, each user will query the `OE.CUSTOMERS` table.

1. Connect as user Alberto Errazuriz.

```
connect aerrazuriz@pdb_name
Enter password: password
```

2. Set column widths for the table output.

```
column cust_first_name format a25
column cust_last_name format a25
column ols_label format a10
```

3. Run the following query:

```
SELECT CUST_FIRST_NAME, CUST_LAST_NAME, ACCOUNT_MGR_ID,
LABEL_TO_CHAR(OLS_COL) OLS_LABEL
FROM OE.CUSTOMERS
ORDER BY OLS_COL;
```

The output should be similar to the following:

CUST_FIRST_NAME	CUST_LAST_NAME	ACCOUNT_MGR_ID	OLS_LABEL
Hal	Olin	147	D::EU
Hannah	Kanth	147	D::EU
Hannah	Field	147	D::EU
Margret	Powell	147	D::EU
Harry Mean	Taylor	147	D::EU
Margrit	Garner	147	D::EU
Maria	Warden	147	D::EU
Marilou	Landis	147	D::EU
...			

76 rows selected.

Because Alberto Errazuriz is assigned the `D` level with the `EU` group, the output is `D::EU`.

4. Repeat this query for the other sales managers:
 - Asian sales manager Gerald Cambraut (`gcambraut`), whose output in the `OLS_LABEL` column should be `D:AS`, with 58 rows returned.
 - US sales manager John Russell (`jrussell`), whose output in the `OLS_LABEL` column should be `D:US1`, with 111 rows returned.
 - Elena Zlotkey (`ezlotkey`), whose output in the `OLS_LABEL` column should be `D:US2`, with 74 rows returned.
5. Connect as president Steven King.

```
connect sking@pdb_name
Enter password: password
```

6. Run the query.

```
SELECT CUST_FIRST_NAME, CUST_LAST_NAME, ACCOUNT_MGR_ID,
       LABEL_TO_CHAR(OLS_COL) OLS_LABEL
FROM   OE.CUSTOMERS
ORDER BY OLS_COL;
```

The output should be similar to the following:

CUST_FIRST_NAME	CUST_LAST_NAME	ACCOUNT_MGR_ID	OLS_LABEL
Kelly	Lange	147	D::EU
Kenneth	Redford	147	D::EU
Rick	Lyon	147	D::EU
Mammutti	Sutherland	147	D::EU
Margaret	Ustinov	147	D::EU
Kevin	Cleveland	147	D::EU
Klaus Maria	Russell	147	D::EU
Kris	de Niro	147	D::EU
Alain	Barkin	147	D::EU
Albert	Dutt	147	D::EU
Amanda	Finney	147	D::EU
...			
Dom	McQueen	149	D::US2
Dom	Hoskins	149	D::US2
Don	Siegel	149	D::US2
Gvtz	Bradford	149	D::US2
Holly	Kurosawa	149	D::US2
Rob	MacLaine	149	D::US2
Don	Barkin	149	D::US2
Meg	Sen	149	D::US2
...			

319 rows selected.

Because Steven King is assigned the GS parent group, the output in the OLS_LABEL column includes all four child groups: D::EU, D::AS, D::US1, and D::US2.

9.9 Step 8: Optionally, Remove the Oracle Label Security Policy Components

You can remove the Oracle Label Security policy, OE_CUST role, and the user accounts.

1. Connect as a user who can create and manage Oracle Label Security policies.

For example:

```
sqlplus psmith_ols@pdb_name
Enter password: password
```

2. Drop the Oracle Label Security policy.

This procedure also removes the levels, groups, and from the OE.CUSTOMERS table, the OLS_COL column.

```
BEGIN
  SA_SYSDBA.DROP_POLICY (
    policy_name => 'OE_OLS_POL',
    drop_column => TRUE);
```

```
END;  
/
```

3. Connect as user who has privileges to drop roles and user accounts.

For example:

```
connect sec_admin@pdb_name  
Enter password: password
```

4. Drop the OE_CUST role.

```
DROP ROLE OE_CUST;
```

5. Drop the user accounts.

```
DROP USER SKING;  
DROP USER AERRAZURIZ;  
DROP USER GCAMBRAULT;  
DROP USER JRUSSELL;  
DROP USER EZLOTKEY;
```


Part IV

Administering an Oracle Label Security Application

Part IV describes how to administer an Oracle Label Security application.

- [Implementing Policy Enforcement Options and Labeling Functions](#)
You can customize the enforcement of Oracle Label Security policies and implement labeling functions.
- [Administering and Using Trusted Stored Program Units](#)
You can use trusted stored program units to enhance system security.
- [Using Oracle Label Security with a Distributed Database](#)
You should understand the special considerations for using Oracle Label Security in a distributed configuration.
- [Performing DBA Functions Under Oracle Label Security](#)
Oracle Label Security supports the standard Oracle Database utilities, but certain restrictions apply, which may require extra steps to get the expected results.
- [Releasability Using Inverse Groups](#)
Oracle Label Security can implement the releasability using inverse groups.
- [Auditing Oracle Label Security](#)
All activities in Oracle Label Security can be audited, including Oracle Label Security administrator activities.

10

Implementing Policy Enforcement Options and Labeling Functions

You can customize the enforcement of Oracle Label Security policies and implement labeling functions.

- [Using the LBAC_TRIGGER Schema](#)
Managing OLS triggers when upgrading to Oracle Database 23ai and downgrading.
- [Oracle Label Security Policy Enforcement Options](#)
Oracle Label Security provides a set of policy enforcement options.
- [Labeling Functions](#)
Labeling functions can compute and return a label using resources such as context variables (for example, date or username) and data values.
- [Inserting Labeled Data Using Policy Options and Labeling Functions](#)
It is important to understand how enforcement options and labeling functions affect the insertion of labeled data.
- [Inserts of Rows into Foreign Key Tables That Do Not Exist Yet in Referential Tables](#)
If you insert a row into a foreign key table that does not yet exist in the referenced table with a primary key, then an `ORA-28117: integrity constraint violated - parent record not found` error occurs when you run the statement to perform the insert, not at COMMIT time.
- [Updating Labeled Data Using Policy Options and Labeling Functions](#)
Users must be authorized to change rows that are protected by Oracle Label Security.
- [Deletion of Labeled Data Using Policy Options and Labeling Functions](#)
You can delete labeled data.
- [SQL Predicates with an Oracle Label Security Policy](#)
You can use a SQL predicate to provide extensibility for selective enforcement of data access rules.

10.1 Using the LBAC_TRIGGER Schema

Managing OLS triggers when upgrading to Oracle Database 23ai and downgrading.

- [About Using the LBAC_TRIGGER Schema](#)
Managing OLS triggers when upgrading to Oracle Database 23ai and downgrading.
- [Migrating Existing LBACSYS Triggers to the LBAC_TRIGGER Schema](#)
If there are DML triggers in the `LBACSYS` schema, then you must migrate them to the `LBAC_TRIGGER` schema
- [Downgrading to an Oracle Database Release Earlier than Release 23ai](#)
If you must downgrade to a pre-Oracle Database 23ai release, then the downgrade will fail if the `LBAC_TRIGGER` schema has triggers.

10.1.1 About Using the LBAC_TRIGGER Schema

Managing OLS triggers when upgrading to Oracle Database 23ai and downgrading.

When you create a custom label function, Oracle Label Security creates internal triggers and invokes these triggers before or after an insert or an update of a row. This action generates the new label that is written into the label column of the table. In previous releases, these internal triggers were created in the common LBACSYS schema. Starting in Oracle Database release 23ai, these triggers are created in the local (PDB) LBAC_TRIGGER schema and are also dictionary protected. Therefore, the LBAC_TRIGGER schema stores the DML triggers for the following operations: before INSERT, after INSERT, before UPDATE, and after UPDATE.

When you upgrade to Oracle Database release 23ai or later, the internal triggers in the LBACSYS from previous releases remain there until you migrate them to the LBAC_TRIGGER schema. Be aware that if you must downgrade the Oracle database to a release earlier than release 23ai, then you must move any triggers that are in the LBAC_TRIGGER schema to another schema, such as LBACSYS.

If you do not migrate the triggers after upgrading to Oracle Database 23ai, then they will continue to work in the LBACSYS schema. However, Oracle strongly recommends that you migrate them to the LBAC_TRIGGER schema so that your Oracle Label Security policies will benefit by having stronger security and meet future compatibility requirements.

10.1.2 Migrating Existing LBACSYS Triggers to the LBAC_TRIGGER Schema

If there are DML triggers in the LBACSYS schema, then you must migrate them to the LBAC_TRIGGER schema

1. Log in to the PDB as a user who can create and manage Oracle Label Security policies.
2. Query the ALL_SA_TABLE_POLICIES data dictionary view.

ALL_SA_TABLE_POLICIES lists the policy, schema, table, and function that are associated with the triggers that you need to migrate. You will need this information for later steps in this procedure.

3. Disable or remove the table policy for the affected tables.

For example, to disable a table policy:

```
BEGIN
  SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY(
    policy_name    => 'hr_ols_pol',
    schema_name    => 'HR');
END;
/
```

To remove a table policy:

```
BEGIN
  SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY(
    policy_name    => 'ols_admin_pol',
    schema_name    => 'HR',
    drop_column    => TRUE);
```

```
END;
/
```

4. Revoke the EXECUTE privilege for label functions that are used on the LBACSYS schema.

For example:

```
REVOKE EXECUTE ON hs FROM LBACSYS;
```

5. Grant the EXECUTE privilege to the label functions that are used for the LBAC_TRIGGER schema.

For example:

```
GRANT EXECUTE ON hs TO LBAC_TRIGGER;
```

6. Enable or apply the table policy for the affected tables.

For example, to enable a table policy:

```
BEGIN
  SA_POLICY_ADMIN.ENABLE_TABLE_POLICY(
    policy_name => 'hr_ols_pol',
    schema_name => 'HR',
    table_name  => 'EMPLOYEES');
END;
/
```

To apply a table policy:

```
BEGIN
  SA_POLICY_ADMIN.APPLY_TABLE_POLICY(
    policy_name  => 'ols_admin_pol',
    schema_name  => 'HR',
    table_name   => 'EMPLOYEES',
    table_options => NULL,
    label_function => 'hs(:new.dept,:new.status)',
    predicate    => 'no_control');
END;
/
```

10.1.3 Downgrading to an Oracle Database Release Earlier than Release 23ai

If you must downgrade to a pre-Oracle Database 23ai release, then the downgrade will fail if the LBAC_TRIGGER schema has triggers.

1. Log in to the PDB as a user who can create and manage Oracle Label Security policies.
2. Query the ALL_SA_TABLE_POLICIES data dictionary view.

ALL_SA_TABLE_POLICIES lists the policy, schema, table, and function that are associated with the triggers that you need to migrate. You will need this information for later steps in this procedure.

3. Disable or remove the table policy for the affected tables.

For example, to disable a table policy:

```
BEGIN
  SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY(
    policy_name => 'hr_ols_pol',
    schema_name => 'HR');
END;
/
```

To remove a table policy:

```
BEGIN
  SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY(
    policy_name => 'ols_admin_pol',
    schema_name => 'HR',
    drop_column => TRUE);
END;
/
```

4. Revoke the EXECUTE privilege for label functions that are used on the LBAC_TRIGGER schema.

For example:

```
REVOKE EXECUTE ON hs FROM LBAC_TRIGGER;
```

5. Perform the downgrade from Oracle Database release 23ai or later.

After the downgrade is complete, applying the table policy will create the triggers within LBACSYS schema.

6. Grant the EXECUTE privilege to the label functions that are used for the LBACSYS schema.

For example:

```
GRANT EXECUTE ON hs TO LBACSYS;
```

7. Enable or apply the table policy for the affected tables.

For example, to enable a table policy:

```
BEGIN
  SA_POLICY_ADMIN.ENABLE_TABLE_POLICY(
    policy_name => 'hr_ols_pol',
    schema_name => 'HR',
    table_name => 'EMPLOYEES');
END;
/
```

To apply a table policy:

```
BEGIN
  SA_POLICY_ADMIN.APPLY_TABLE_POLICY(
    policy_name => 'ols_admin_pol',
    schema_name => 'HR',
    table_name => 'EMPLOYEES',
```

```
table_options => NULL,  
label_function => 'hs(:new.dept,:new.status) ',  
predicate     => 'no_control');  
END;  
/
```

10.2 Oracle Label Security Policy Enforcement Options

Oracle Label Security provides a set of policy enforcement options.

- [About Policy Enforcement Options](#)
The administrator must choose the Oracle Label Security enforcement controls that meet the needs of the given application.
- [Policy Enforcement Scopes](#)
You can enforce policies at the policy, schema, and table scopes.
- [Categories of Policy Enforcement Options](#)
Oracle Label Security enforces policies using three categories: label management options, access control options, and overriding options.
- [Relationships of Policy Enforcement Options](#)
Oracle Label Security has a set of policy enforcement options.
- [How the HIDE Policy Column Option Works](#)
You can specify the `HIDE` policy configuration option when you add an Oracle Label Security policy column to a table.
- [Label Management Enforcement](#)
The three label enforcement options control the data label written when a row is inserted or updated.
- [Access Control Enforcement](#)
Access control options limit the rows accessible for `SELECT`, `UPDATE`, `INSERT`, or `DELETE` operations to only those rows whose labels meet established policies.
- [Overriding Enforcement](#)
Whereas `ALL_CONTROL` applies all of the label management and access control enforcement options, `NO_CONTROL` applies none of them.
- [Guidelines for Using the Policy Enforcement Options](#)
You can customize policy enforcement for a schema or table through the Oracle Enterprise Manager.
- [Exemptions from Oracle Label Security Policy Enforcement](#)
Oracle Label Security has several exceptions from OLS policy enforcement.
- [Data Dictionary Views for Viewing Policy Options on Tables and Schemas](#)
Oracle Label Security provides data dictionary views that describe the policy enforcement options currently applied to tables and schemas.

10.2.1 About Policy Enforcement Options

The administrator must choose the Oracle Label Security enforcement controls that meet the needs of the given application.

This means identifying levels of data sensitivity, as well as identifying which users have the need or the right to access or alter such data. The policy enforcement options enable administrators to fine-tune users' abilities to read or write data or labels.

10.2.2 Policy Enforcement Scopes

You can enforce policies at the policy, schema, and table scopes.

[Table 10-1](#) lists the scopes on which policy enforcement options can operate.

Table 10-1 When Policy Enforcement Options Take Effect

Scopes at which enforcement options can be set	Options set at this scope affect user operations ...
Policy scope	... only when the policy has been applied to the table or schema
Schema scope	... whenever a user acts in this schema
Table scope	... whenever a user acts in this table

When you apply a policy to a table or schema, you can specify the enforcement options that will constrain its use. If you do not specify enforcement options at that time, then the default enforcement options you specified when you created that policy are used automatically.

These options customize your policy enforcement to meet your security requirements as to `READ` access, `WRITE` access, and label changes. You can also specify whether the label column should be displayed or hidden. You can choose to enforce some or all of the policy options for any protected table by specifying only those you want.

Optionally, you can assign each table a labeling function, which determines the label of any row inserted or updated in that table. You can also specify, optionally, a `SQL` predicate for a table, to control which rows are accessible to users, based on their labels.

When Oracle Label Security policy enforcement options are applied, they control which rows are accessible to view, insert, update, or delete.

Related Topics

- [Labeling Functions](#)
Labeling functions can compute and return a label using resources such as context variables (for example, date or username) and data values.
- [SQL Predicates with an Oracle Label Security Policy](#)
You can use a `SQL` predicate to provide extensibility for selective enforcement of data access rules.

10.2.3 Categories of Policy Enforcement Options

Oracle Label Security enforces policies using three categories: label management options, access control options, and overriding options.

[Table 10-2](#) lists the categories of policy enforcement options.

- Label management options ensure that data labels written for inserted or updated rows do not violate policies set for such labels
- Access control options ensure that only rows whose labels meet established policies are accessible for `SELECT`, `UPDATE`, `INSERT`, or `DELETE` operations.
- Overriding options can suspend or apply all other enforcement options.

Table 10-2 Policy Enforcement Options

Type of Enforcement	Option	Description
Label Management Enforcement	LABEL_DEFAULT	Uses the session's default row label value unless the user explicitly specifies a label on INSERT.
	LABEL_UPDATE	Applies policy enforcement to UPDATE operations that set or change the value of a label attached to a row. The WRITEUP, WRITEDOWN, and WRITEACROSS privileges are enforced only if the LABEL_UPDATE option is active.
	CHECK_CONTROL	Applies READ_CONTROL policy enforcement to INSERT and UPDATE statements to assure that the new row label is read-accessible.
Access Control Enforcement	READ_CONTROL	Applies policy enforcement to all queries. Only authorized rows are accessible for SELECT, UPDATE, and DELETE operations. See INSERT_CONTROL , UPDATE_CONTROL , and DELETE_CONTROL .
	WRITE_CONTROL	Determines the ability to INSERT, UPDATE, and DELETE data in a row. If this option is active, it enforces INSERT_CONTROL, UPDATE_CONTROL, and DELETE_CONTROL.
	INSERT_CONTROL	Applies policy enforcement to INSERT operations, according to the algorithm for write access described in the figure in How Oracle Label Security Algorithm for Read Access Works .
	DELETE_CONTROL	Applies policy enforcement to DELETE operations, according to the algorithm for write access described in the figure in How Oracle Label Security Algorithm for Read Access Works .
	UPDATE_CONTROL	Applies policy enforcement to UPDATE operations on the data columns within a row, according to the algorithm for write access described in the figure in How Oracle Label Security Algorithm for Read Access Works .
Overriding Enforcement	ALL_CONTROL	Applies all enforcement options.
	NO_CONTROL	Applies no enforcement options. A labeling function or a SQL predicate can nonetheless be applied.

Remember that even when Oracle Label Security is applicable to a table, some DML operations may not be covered by the policies being applied. The policy enforcement options set by the administrator determine both the SQL processing behavior and what an authorized user can actually see in response to a query on a protected table. Except where noted, this chapter assumes that ALL_CONTROL is active, meaning that all enforcement options are in effect. If users attempt to perform an operation for which they are not authorized, then an error message is raised and the SQL statement fails.

Understanding the relationships among these policy enforcement options, and what SQL statements they control, is essential to their effective use in designing and implementing your Oracle Label Security policies.

Related Topics

- [Implementation of Inverse Groups with INVERSE_GROUP Enforcement](#)
When creating an Oracle Label Security policy, you can specify whether the policy can use inverse group functionality to implement releasability.

10.2.4 Relationships of Policy Enforcement Options

Oracle Label Security has a set of policy enforcement options.

[Table 10-3](#) describes the relationships between policy enforcement options.

Table 10-3 What Policy Enforcement Options Control

Specifying This Option in a Policy	Controls These SQL Operations	Using These Criteria and with These Effects
READ_CONTROL	SELECT, UPDATE, and DELETE	Only authorized rows (*) are accessible.
WRITE_CONTROL	INSERT, UPDATE, and DELETE	(a) Only authorized rows (**) are accessible (b) Data labels writable unless LABEL_UPDATE is active.
WRITE_CONTROL (necessary for INSERT_CONTROL, UPDATE_CONTROL, and DELETE_CONTROL)	-	-
INSERT_CONTROL	INSERT	-
UPDATE_CONTROL	UPDATE	-
DELETE_CONTROL	DELETE	-
CHECK_CONTROL	-	Applies READ_CONTROL policy enforcement to INSERT and UPDATE statements to assure that the new row label is read-accessible.
Access Control Enforcement	-	Applies policy enforcement to all queries. Only authorized rows are accessible for operations.
INSERT_CONTROL	INSERT_CONTROL	Applies policy enforcement to INSERT operations.
DELETE_CONTROL	DELETE_CONTROL	Applies policy enforcement to DELETE operations.
UPDATE_CONTROL	UPDATE_CONTROL	Applies policy enforcement to UPDATE operations on the data columns within a row.
Overriding Enforcement	ALL_CONTROL	Applies all enforcement options.
NO_CONTROL	NO_CONTROL	Applies no enforcement options. A labeling function or a SQL predicate can nonetheless be applied.

(*) A row is authorized for READ access if the following three criteria are all met: (user-minimum-level) <= (data-row-level) <= (session-level) (any-data-group) is a child of (any-user-group-or-childgroup) (every-data-compartment) is also in (the user's compartments). Refer to the figure in [How Oracle Label Security Algorithm for Read Access Works](#)

(**) A row is authorized for READ access if the following three criteria are all met: (user-minimum-level) <= (data-row-level) <= (session-level) (any-data-group) is a child of (any-user-group-or-childgroup) (every-data-compartment) is also in (the user's compartments). Refer to the figure in [How Oracle Label Security Algorithm for Read Access Works](#).

10.2.5 How the HIDE Policy Column Option Works

You can specify the HIDE policy configuration option when you add an Oracle Label Security policy column to a table.

This prevents display of the column containing the policy's labels.

Once the policy has been applied, the hidden (or not hidden) status of the column cannot be changed unless the policy is removed with the `DROP_COLUMN` parameter set to `TRUE`. Then, the policy can be reapplied with a new hidden status.

`INSERT` statements doing all-column inserts do not require the values for hidden label columns.

`SELECT` statements do not automatically return the values of hidden label columns. Such values must be explicitly retrieved.

A `DESCRIBE` on a table may or may not display the label column. If the administrator sets the `HIDE` option, then the label column will not be displayed. If `HIDE` is not specified for a policy, then the label column is displayed in response to a `SELECT`.

Related Topics

- [SA_POLICY_ADMIN.APPLY_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` procedure adds the specified policy to a table.
- [Retrieving All Columns from a Table When the Policy Label Column Is Hidden](#)
If the policy label column is hidden, then it is not automatically returned when you run `SELECT *` on the table.

10.2.6 Label Management Enforcement

The three label enforcement options control the data label written when a row is inserted or updated.

- [About the Label Management Enforcement Options](#)
When a policy specifies the options and is applied to a table or schema, these options apply to special situations.
- [LABEL_DEFAULT: Using the Session's Default Row Label](#)
A user can update a row without specifying a label value, because the updated row uses its original label.
- [LABEL_UPDATE: Changing Data Labels](#)
A user updating a row can normally change its label to any label within their authorized label range.
- [CHECK_CONTROL: Checking Data Labels](#)
If an inserted or updated row gets its label from a labeling function, the label could be outside the user's authorizations.

10.2.6.1 About the Label Management Enforcement Options

When a policy specifies the options and is applied to a table or schema, these options apply to special situations.

A user inserting a row can specify any data label within the range of the user's label authorizations. If the user does not specify a label for the row being written, `LABEL_DEFAULT` can do so. Updates can be restricted by `LABEL_UPDATE`. Inserts or updates that use a labeling function need `CHECK_CONTROL` to prevent assigning a data label outside the user's authorizations. Such a label would prevent the user from accessing the row just written, and could enable the user to make data available inappropriately.

Any labeling function in force on a table overrides these options. Such a function can be named in the call that applies the policy to the table. If the administrator named such a function

when applying a policy, but then disables or removes that policy, then that function is no longer applied.

Related Topics

- [SA_SYSDBA.DISABLE_POLICY](#)
The `SA_SYSDBA.DISABLE_POLICY` procedure turns off enforcement of a policy, without removing it from the database.

10.2.6.2 LABEL_DEFAULT: Using the Session's Default Row Label

A user can update a row without specifying a label value, because the updated row uses its original label.

However, to insert a new row, the user must supply a valid label unless a labeling function is in force or `LABEL_DEFAULT` applies for the table. `LABEL_DEFAULT` causes the user's session default row label to be used as the new row label.

If neither `LABEL_DEFAULT` nor a labeling function is in force and the user attempts to `INSERT` a row, then an error occurs.

Note that any labeling function in force on a table overrides the `LABEL_DEFAULT` option.

10.2.6.3 LABEL_UPDATE: Changing Data Labels

A user updating a row can normally change its label to any label within their authorized label range.

However, if `LABEL_UPDATE` applies, then to modify a label, the user must have one or more of these privileges: `WRITEUP`, `WRITEDOWN`, and `WRITEACROSS`.

The `LABEL_UPDATE` option uses an Oracle after-row trigger which is called only on an update operation affecting the label. Note that any labeling function in force on a table overrides the `LABEL_UPDATE` option.

Related Topics

- [Special Row Label Privileges](#)
Once the label on a row has been set, Oracle Label Security privileges are required to modify the label.

10.2.6.4 CHECK_CONTROL: Checking Data Labels

If an inserted or updated row gets its label from a labeling function, the label could be outside the user's authorizations.

This prevents this user from being able to read or update the row. To prevent this problem, use the `CHECK_CONTROL` setting to allow `READ_CONTROL` to apply to the new label. This ensures that this user will be authorized to read the inserted or updated row after the operation. If not, then the insert or update operation is canceled and has no effect.

In other words, if `CHECK_CONTROL` is included as an option in a policy being enforced on a row, then the user modifying that row must still be able to access it after the operation. `CHECK_CONTROL` prevents a user or a labeling function from modifying a row's label to include a level, group, or compartment that the modifying user would be prevented from accessing.

Note that `CHECK_CONTROL` overrides any labeling function in force on a table.

10.2.7 Access Control Enforcement

Access control options limit the rows accessible for `SELECT`, `UPDATE`, `INSERT`, or `DELETE` operations to only those rows whose labels meet established policies.

- **READ_CONTROL: Reading Data**
`READ_CONTROL` limits the set of records accessible to a session for `SELECT`, `UPDATE` and `DELETE` operations.
- **WRITE_CONTROL: Writing Data**
When an Oracle Label Security policy specifying the `WRITE_CONTROL` option is applied to a table, triggers are generated and the algorithm is enforced.
- **INSERT_CONTROL, UPDATE_CONTROL, and DELETE_CONTROL**
The `INSERT_CONTROL`, `UPDATE_CONTROL`, and `DELETE_CONTROL` options control policy enforcement during the corresponding operations on the data columns in a row.

10.2.7.1 READ_CONTROL: Reading Data

`READ_CONTROL` limits the set of records accessible to a session for `SELECT`, `UPDATE` and `DELETE` operations.

If `READ_CONTROL` is not active, then even rows in the table protected by the policy are accessible to all users.

`READ_CONTROL` uses Oracle virtual private database (VPD) technology to enforce the read access mediation algorithm illustrated in [Figure 3-6](#).

10.2.7.2 WRITE_CONTROL: Writing Data

When an Oracle Label Security policy specifying the `WRITE_CONTROL` option is applied to a table, triggers are generated and the algorithm is enforced.

`WRITE_CONTROL` uses Oracle after-row triggers to enforce the write access mediation algorithm illustrated in [Figure 3-7](#).

 **Note:**

The protection implementation for `WRITE_CONTROL` is the same for all write operations, but you need not apply all write options across the board. You can apply `WRITE_CONTROL` selectively for `INSERT`, `UPDATE`, and `DELETE` operations by using the corresponding policy enforcement option (`INSERT_CONTROL`, `UPDATE_CONTROL`, and `DELETE_CONTROL`) instead of `WRITE_CONTROL`.

If `WRITE_CONTROL` is on but `LABEL_UPDATE` is not specified, then the user can change both data and labels. If you want to control updating the row labels, then specify the `LABEL_UPDATE` option in addition to `WRITE_CONTROL` when creating your policies.

10.2.7.3 INSERT_CONTROL, UPDATE_CONTROL, and DELETE_CONTROL

The `INSERT_CONTROL`, `UPDATE_CONTROL`, and `DELETE_CONTROL` options control policy enforcement during the corresponding operations on the data columns in a row.

These options apply according to the algorithm for write access described in [Figure 3-7](#).

Specifying `WRITE_CONTROL` limits all `INSERT`, `UPDATE`, and `DELETE` operations. However,

- Specifying `INSERT_CONTROL` limits insertions but not updates or deletes.
- Specifying `UPDATE_CONTROL` limits updates but not insertions or deletes.
- Specifying `DELETE_CONTROL` limits deletes but not insertions or updates.

Related Topics

- [Inserting Labeled Data Using Policy Options and Labeling Functions](#)
It is important to understand how enforcement options and labeling functions affect the insertion of labeled data.
- [Updating Labeled Data Using Policy Options and Labeling Functions](#)
Users must be authorized to change rows that are protected by Oracle Label Security.
- [Deletion of Labeled Data Using Policy Options and Labeling Functions](#)
You can delete labeled data.

10.2.8 Overriding Enforcement

Whereas `ALL_CONTROL` applies all of the label management and access control enforcement options, `NO_CONTROL` applies none of them.

In either case, labeling functions and SQL predicates can be applied. Note that the `ALL_CONTROL` option can be used only on the command line. If you apply a policy with `NO_CONTROL` specified, then a policy label column is added to the table, but the label values are `NULL`. Because no access controls are operating on the table, you can proceed to enter labels as desired. You can then set the policy enforcement options as you want. `NO_CONTROL` can be a useful option if you have a labeling function in force to label the data correctly, but want to let all users access all the data.

10.2.9 Guidelines for Using the Policy Enforcement Options

You can customize policy enforcement for a schema or table through the Oracle Enterprise Manager.

This functionality is described in [Creating an Oracle Label Security Policy](#) or you can use the `SA_POLICY_ADMIN` package as described in [SA_POLICY_ADMIN Policy Administration PL/SQL Package](#).

This section documents the supported keywords.

Note that when you create a policy, you can specify a string of default options to be used whenever the policy is applied without schema or table options being specified.

If a policy is first applied to a table, and then also applied to the schema containing that table, then the options on the table are not affected by the schema policy. The options of the policy originally applied to the table remain in force.

In general, administrators use the `LABEL_DEFAULT` policy option, causing data written by a user to be labeled with that user's row label. Alternatively, a labeling function can be used to label the data. If neither of these two choices is used, then a label must be specified in every `INSERT` statement. (Updates retain the row's original label.)

The following table suggests that certain combinations of policy enforcement options are useful when implementing an Oracle Label Security policy. As the table indicates, you might typically

enforce `READ_CONTROL` and `WRITE_CONTROL`, choosing from among several possible combinations for setting the data label on writes.

Table 10-4 Suggested Policy Enforcement Option Combinations

Options	Access Enforcement
<code>READ_CONTROL</code> , <code>WRITE_CONTROL</code> , <code>LABEL_DEFAULT</code>	Read and write access based on session label. Default label provided; users can insert/update both data and labels.
<code>READ_CONTROL</code> , <code>WRITE_CONTROL</code> , Labeling Function	Read and write access based on session label. Users can set/change only row data; all row labels are set explicitly by the labeling function. Add <code>CHECK_CONTROL</code> to restrict new labels (on insert or update) to visible range of labels.
<code>READ_CONTROL</code> , <code>WRITE_CONTROL</code> , <code>LABEL_UPDATE</code>	Read and write access based on session label. Users cannot change labels without privileges. Add <code>CHECK_CONTROL</code> to restrict new labels (on insert or update) to visible range.

Related Topics

- [Authorized Levels](#)
The administrator explicitly sets the level authorization for an Oracle Label Security policy.

10.2.10 Exemptions from Oracle Label Security Policy Enforcement

Oracle Label Security has several exceptions from OLS policy enforcement.

These exemptions are as follows:

- Oracle Label Security is not enforced during `DIRECT` path export.
- By design, Oracle Label Security policies cannot be applied to objects in schema `SYS`. As a consequence, the `SYS` user, and users making a DBA-privileged connection to the database (such as `CONNECT AS SYSDBA`) do not have Oracle Label Security policies applied to their actions. DBAs need to be able to administer the database. It would make no sense, for example, to export part of a table due to an Oracle Label Security policy being applied. The database user `SYS` is thus always exempt from Oracle Label Security enforcement, regardless of the export mode, application, or utility used to extract data from the database.
- Similarly, database users granted the `EXEMPT ACCESS POLICY` privilege, either directly or through a database role, are exempted from some Oracle Label Security policy enforcement controls such as `READ_CONTROL` and `CHECK_CONTROL`, regardless of the export mode, application or utility used to access the database or update its data. The following policy enforcement options remain in effect even when `EXEMPT ACCESS POLICY` is granted:
 - `INSERT_CONTROL`, `UPDATE_CONTROL`, `DELETE_CONTROL`, `WRITE_CONTROL`, `LABEL_UPDATE`, and `LABEL_DEFAULT`.
 - If the Oracle Label Security policy specifies the `ALL_CONTROL` option, then all enforcement controls are applied except `READ_CONTROL` and `CHECK_CONTROL`.

`EXEMPT ACCESS POLICY` is a very powerful privilege and should be carefully managed.

Note that this privilege does not affect the enforcement of standard Oracle Database object privileges such as `SELECT`, `INSERT`, `UPDATE`, and `DELETE`. These privileges are enforced even if a user has been granted the `EXEMPT ACCESS POLICY` privilege.

Related Topics

- [Categories of Policy Enforcement Options](#)
Oracle Label Security enforces policies using three categories: label management options, access control options, and overriding options.

10.2.11 Data Dictionary Views for Viewing Policy Options on Tables and Schemas

Oracle Label Security provides data dictionary views that describe the policy enforcement options currently applied to tables and schemas.

- `DBA_SA_TABLE_POLICIES`
- `DBA_SA_SCHEMA_POLICIES`

10.3 Labeling Functions

Labeling functions can compute and return a label using resources such as context variables (for example, date or username) and data values.

- [Labeling Data Rows under Oracle Label Security](#)
There are three ways to label data that is being inserted or updated.
- [How Labeling Functions in Oracle Label Security Policies Works](#)
Labeling functions enable you to consider, in your rules for assigning labels, information drawn from the application context.
- [Creating a Labeling Function for a Policy](#)
You can use the `CREATE OR REPLACE FUNCTION` SQL statement to create a labeling function.
- [Specifying a Labeling Function in a Policy](#)
You can use the `SA_POLICY_ADMIN` package to specify a labeling function.

10.3.1 Labeling Data Rows under Oracle Label Security

There are three ways to label data that is being inserted or updated.

- You can explicitly specify a label in every `INSERT` or `UPDATE` to the table.
- You can set the `LABEL_DEFAULT` option, which causes the session's row label to be used if an explicit row label is not included in the `INSERT` or `UPDATE` statement.
- You can create a labeling function, automatically calls on every `INSERT` or `UPDATE` statement and independently of any user's authorization.

The recommended approach is to write a labeling function to implement your rules for labeling data. If you specify a labeling function, then Oracle Label Security embeds a call to that function in `INSERT` and `UPDATE` triggers to compute a label.

For example, you could create a labeling function named `my_label` to use the contents of `COL1` and `COL2` of the new row to compute and return the appropriate label for the row. Then, you could insert, into your `INSERT` or `UPDATE` statements, the following reference:

```
my_label (:new.col1, :new.col2)
```

If you do not specify a labeling function, then specify the `LABEL_DEFAULT` option. Otherwise, you must explicitly specify a label on every `INSERT` or `UPDATE` statement.

10.3.2 How Labeling Functions in Oracle Label Security Policies Works

Labeling functions enable you to consider, in your rules for assigning labels, information drawn from the application context.

For example, you can use as a labeling consideration the IP address to which the user is attached. There are many opportunities to use `SYS_CONTEXT` in this way.

Note:

If the SQL statement is invalid, then an error will occur when you apply the labeling function to the table or policy. You should thoroughly test a labeling function before using it with tables.

Labeling functions override the `LABEL_DEFAULT` and `LABEL_UPDATE` options.

A labeling function is called in the context of a before-row trigger. This enables you to pass in the old and new values of the data record, as well as the old and new labels.

You can construct a labeling function to permit an explicit label to be passed in by the user.

All labeling functions must have return types of the `LBACSYS.LBAC_LABEL` data type. The `TO_LBAC_DATA_LABEL` function can be used to convert a label in character string format to a data type of `LBACSYS.LBAC_LABEL`. Note that `LBACSYS` must have the `EXECUTE` privilege on your labeling function. The owner of the labeling function must have the `EXECUTE` privilege on the `LBAC_TRIGGER` schema, with the `GRANT` option.

Note:

`LBACSYS` is a unique schema providing opaque types for Oracle Label Security.

Related Topics

- [Performing DBA Functions Under Oracle Label Security](#)
Oracle Label Security supports the standard Oracle Database utilities, but certain restrictions apply, which may require extra steps to get the expected results.

10.3.3 Creating a Labeling Function for a Policy

You can use the `CREATE OR REPLACE FUNCTION` SQL statement to create a labeling function.

- To use the `CREATE OR REPLACE FUNCTION` statement to create a labeling function for a policy, set the return value to `LBACSYS.LBAC_LABEL`.

For example:


```

CREATE OR REPLACE FUNCTION sa_demo.gen_emp_label
    (Job varchar2,
     Deptno number,
     Total_sal number)
    Return LBACSYS.LBAC_LABEL
as
    i_label varchar2(80);
Begin
    /***** Determine Class Level *****/
    if total_sal > 2000 then
        i_label := 'L3: ';
    elsif total_sal > 1000 then
        i_label := 'L2: ';
    else
        i_label := 'L1: ';
    end if;

    /***** Determine Compartment *****/
    IF Job in ('MANAGER','PRESIDENT') then
        i_label := i_label||'M: ';
    else
        i_label := i_label||'E: ';
    end if;

    /***** Determine Groups *****/
    i_label := i_label||'D'||to_char(deptno);
    return TO_LBAC_DATA_LABEL('human_resources',i_label);
End;
/

```

10.3.4 Specifying a Labeling Function in a Policy

You can use the `SA_POLICY_ADMIN` package to specify a labeling function.

- Use `SA_POLICY_ADMIN.REMOVE_TABLE_POLICY` and `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` to specify the labeling function.

For example:

```
SA_POLICY_ADMIN.REMOVE_TABLE_POLICY('human_resources','sa_demo','emp');
```

```

SA_POLICY_ADMIN.APPLY_TABLE_POLICY(
    POLICY_NAME      => 'human_resources',
    SCHEMA_NAME      => 'sa_demo',
    TABLE_NAME      => 'emp',
    TABLE_OPTIONS   => 'READ_CONTROL,WRITE_CONTROL,CHECK_CONTROL',
    LABEL_FUNCTION    => 'sa_demo.gen_emp_label(:new.job,:new.deptno,:new.sal)',
    PREDICATE        => NULL);

```

10.4 Inserting Labeled Data Using Policy Options and Labeling Functions

It is important to understand how enforcement options and labeling functions affect the insertion of labeled data.

- [Outcome of Insert or Updates Operations on Data Based on Authorizations](#)
When you attempt to insert or update data based on your authorizations, the outcome depends upon what policy enforcement controls are active.

- [Label Insertions When a Labeling Function Is Specified](#)
A labeling function takes precedence over labels entered by the user.
- [Child Row Insertions in Tables with Declarative Referential Integrity](#)
If declarative referential integrity protects a parent table, then the parent row must be visible before a child row can be inserted.

10.4.1 Outcome of Insert or Updates Operations on Data Based on Authorizations

When you attempt to insert or update data based on your authorizations, the outcome depends upon what policy enforcement controls are active.

- If `INSERT_CONTROL` is active, then rows you insert can only have labels within your write authorizations. If you attempt to update data that you can read, but for which you do not have write authorization, an error is raised. For example, if you can read compartments A and B, but you can only write to compartment A, then if you attempt to insert data with compartment B, then the statement will fail.
- If `INSERT_CONTROL` is *not* active, then you can use any valid label on rows you insert.
- If the `CHECK_CONTROL` option is active, then rows you insert can only have labels you are authorized to read, even if the labels are generated by a labeling function.

10.4.2 Label Insertions When a Labeling Function Is Specified

A labeling function takes precedence over labels entered by the user.

If the administrator has set up an automatic labeling function, then no data label a user enters will have effect (unless the labeling function itself makes use of the user's proposed label). New row labels are always determined by an active labeling function, if present.

Note that a labeling function can set the label of a row being inserted to a value outside the range that the user writing that row can see. If such a function is in use, then the user can potentially insert a row but not be authorized to see that row. You can prevent this situation by specifying the `CHECK_CONTROL` option in the policy. If this option is active, then the new data label is checked against the user's read authorization, and if the user cannot read it, then the insert operation is not performed.

10.4.3 Child Row Insertions in Tables with Declarative Referential Integrity

If declarative referential integrity protects a parent table, then the parent row must be visible before a child row can be inserted.

The user must be able to see the parent row for the insert operation to succeed, that is, the user must have read access to the parent row.

If `READ_CONTROL` is active on the parent table, then the user's read authorization must be sufficient to authorize a `SELECT` operation on the parent row. For example, a user who cannot read department 20 cannot insert child rows for department 20. Note that all records will be visible if the user has `FULL` or `READ` privileges on the table or schema.

10.5 Inserts of Rows into Foreign Key Tables That Do Not Exist Yet in Referential Tables

If you insert a row into a foreign key table that does not yet exist in the referenced table with a primary key, then an `ORA-28117: integrity constraint violated - parent record not found` error occurs when you run the statement to perform the insert, not at `COMMIT` time.

Inserts into a table with a `DEFERRED` foreign key constraint involving an Oracle Label Security protected table are evaluated immediately and not deferred till a `COMMIT` has been performed. This is expected behavior because Oracle Label Security uses label authorizations to while performing referential constraint checks. If the referenced table with the primary key is not Oracle Label Security protected, then the error occurs at `COMMIT` time with normal error messages.

10.6 Updating Labeled Data Using Policy Options and Labeling Functions

Users must be authorized to change rows that are protected by Oracle Label Security.

- [Updating Labels Using CHAR_TO_LABEL](#)
To change a row label from `SENSITIVE` to `CONFIDENTIAL`, you can change the label by using the `CHAR_TO_LABEL` function.
- [Evaluation of Enforcement Control Options and UPDATE](#)
When you attempt to update data based on your authorizations, the outcome depends on which enforcement controls are active.
- [Updates to Labels When a Labeling Function Is Specified](#)
A labeling function takes precedence over labels entered by the user.
- [Updates to Child Rows in Tables with Declarative Referential Integrity Enabled](#)
If a child row is in a table with a referential integrity constraint, then the parent row must be visible for the update to succeed.

10.6.1 Updating Labels Using CHAR_TO_LABEL

To change a row label from `SENSITIVE` to `CONFIDENTIAL`, you can change the label by using the `CHAR_TO_LABEL` function.

- To change a row label, use the `UPDATE SQL` statement.

For example:

```
UPDATE emp
SET hr_label = char_to_label ('HR', 'CONFIDENTIAL')
WHERE ename = 'ESTANTON';
```

10.6.2 Evaluation of Enforcement Control Options and UPDATE

When you attempt to update data based on your authorizations, the outcome depends on which enforcement controls are active.

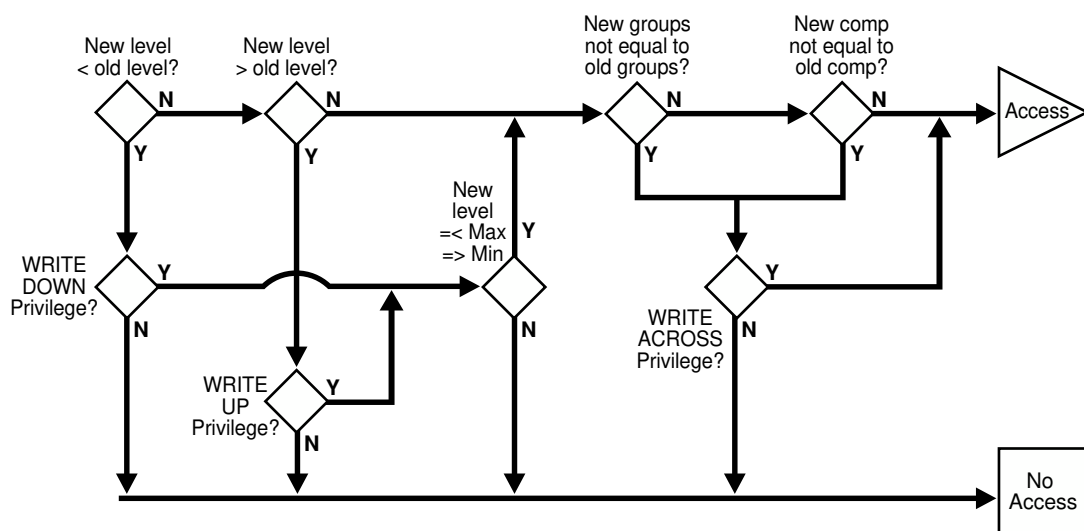
- If `UPDATE_CONTROL` is active, then you can only update rows whose labels fall within your write authorizations. If you attempt to update data that you can read, but for which you do

not have write authorization, then an error is raised. Assume, for example, that you can read compartments A and B, but you can only write to compartment A. In this case, if you attempt to update data with compartment B, then the statement will fail.

- If `UPDATE_CONTROL` is not active, then you can update all rows to which you have read access.
- If `LABEL_UPDATE` is active, then you must have the appropriate privilege (`WRITEUP`, `WRITEDOWN`, or `WRITEACROSS`) to change a label by raising or lowering its sensitivity level, or altering its groups or compartments.
- If `LABEL_UPDATE` is *not* active but `UPDATE_CONTROL` *is* active, then you can update a label to any new label value within your write authorization.
- If `CHECK_CONTROL` is active, then you can only write labels you are authorized to read.

The following figure illustrates the label evaluation process for `LABEL_UPDATE`.

Figure 10-1 Label Evaluation Process for LABEL_UPDATE



10.6.3 Updates to Labels When a Labeling Function Is Specified

A labeling function takes precedence over labels entered by the user.

If the administrator has set up an automatic labeling function, then no label a user enters will have effect (unless the labeling function itself makes use of the user's proposed label). New row labels are always determined by an active labeling function, if present.

Note that the security administrator can establish a labeling function that sets the label of a row being updated to a value outside the range that you can see. If this is the case, then you can update a row, but not be authorized to see the row. If the `CHECK_CONTROL` option is on, then you will not be able to perform such an update. The `CHECK_CONTROL` option verifies your read authorization on the new label.

10.6.4 Updates to Child Rows in Tables with Declarative Referential Integrity Enabled

If a child row is in a table with a referential integrity constraint, then the parent row must be visible for the update to succeed.

That is, this user must be able to see the parent row.

If the parent table has `READ_CONTROL` on, then the user's read authorization must be sufficient to authorize a `SELECT` on the parent row.

For example, a user who cannot read department 20 in a parent table cannot update an employee's department to department 20 in a child table. (If the user has `FULL` or `READ` privilege, then all records will be visible.)



See Also:

Oracle Database Development Guide

10.7 Deletion of Labeled Data Using Policy Options and Labeling Functions

You can delete labeled data.

Note the following:

- If `DELETE_CONTROL` is active, then you can delete only rows within your write authorization.
- If `DELETE_CONTROL` is *not* active, then you can delete only rows that you can read.
- With `DELETE_CONTROL` active, and declarative referential integrity defined with cascading deletes, you must have write authorization on *all* the rows to be deleted, or the statement will fail.

You cannot delete a parent row if there are any child rows attached to it, regardless of your write authorization. To delete such a parent row, you must first delete each of the child rows. If `DELETE_CONTROL` is active on any of the child rows, then you must have write authorization to delete the child rows.

Consider, for example, a situation in which the user is `UNCLASSIFIED` and there are three rows as follows:

Row	Table	Sensitivity
Parent row:	DEPT	UNCLASSIFIED
Child row:	EMP	UNCLASSIFIED
Child row:	EMP	UNCLASSIFIED

In this case, the `UNCLASSIFIED` user cannot delete the parent row.

`DELETE_CONTROL` has no effect when `DELETERESTRICT` is active. `DELETERESTRICT` is always enforced. In some cases (depending on the user's authorizations and the data's labels) it may look as though a row has no child rows, when it actually does have children but the user cannot see them. Even if a user cannot see child rows, they still cannot delete the parent row.

10.8 SQL Predicates with an Oracle Label Security Policy

You can use a SQL predicate to provide extensibility for selective enforcement of data access rules.

- [Modifications to an Oracle Label Security Policy with a SQL Predicate](#)
A SQL predicate is a condition, optionally preceded by `AND` or `OR`.
- [How Multiple SQL Predicates Affect Oracle Label Security Policies](#)
Predicates can be appended to other predicates.

10.8.1 Modifications to an Oracle Label Security Policy with a SQL Predicate

A SQL predicate is a condition, optionally preceded by `AND` or `OR`.

The SQL predicate can be appended for `READ_CONTROL` access mediation. The following predicate, for example, adds an application-specific test based on `COL1` to determine if the session has access to the row.

```
AND my_function(col1)=1
```

The combined result of the policy and the user-specified predicate limits the rows that a user can read. So, this combination affects the labels and data that `CHECK_CONTROL` will permit a user to change. An `OR` clause, for example, increases the number of rows a user can read.

A SQL predicate can be useful if you want to avoid performing label-based filtering. In certain situations, a SQL predicate can easily implement row-level security on tables. Used instead of `READ_CONTROL`, a SQL predicate will filter the data for `SELECT`, `UPDATE`, and `DELETE` operations.

Similarly, in a typical, Web-enabled human resources application, a user might have to be a manager to access rows in the employee table. In such cases, the user's user label would have to dominate the label on the employee's row. A SQL predicate like the following could be added, so that an employee could bypass label-based filtering if they wanted to view their own record in the employee table. (An `OR` is used so that *either* the label policy will apply, *or* this statement will apply.)

```
OR SYS_CONTEXT ('USERENV', 'SESSION_USER') = employee_name
```

This predicate enables you to have additional access controls so that each employee can access their own record.

You can use such a predicate in conjunction with `READ_CONTROLS` or as a standalone predicate even if `READ_CONTROL` is not implemented.

 **Note:**

Verify that the predicate accomplishes your security goals before you implement it in an application.

If a syntax error occurs in a predicate under Oracle Label Security, then an error will *not* arise when you try to apply the policy to a table. Rather, a predicate error message will arise when you first attempt to reference the table.

10.8.2 How Multiple SQL Predicates Affect Oracle Label Security Policies

Predicates can be appended to other predicates.

A predicate applied to a table with an Oracle Label Security policy is appended to other predicates that are applied by other Oracle Label Security policies, or by Oracle Database fine-grained access control or Oracle Virtual Private Database policies. The predicates are **AND**ed together.

Consider the following predicates applied to the `EMP` table in the `SCOTT` schema:

- A predicate generated by an Oracle VPD policy, such as `deptno=10`
- A label-based predicate generated by an Oracle Label Security policy, such as `label=100`, with a user-specified predicate such as

```
OR SYS_CONTEXT ('USERENV', 'SESSION_USER') = ename
```

Correct: These predicates would be **AND**ed together as follows:

```
WHERE deptno=10 AND (label=100 OR SYS_CONTEXT ('USERENV', 'SESSION_USER') = ename)
```

Incorrect: The predicates would *not* be combined in the following way:

```
WHERE deptno=10 AND label=100 OR SYS_CONTEXT ('USERENV', 'SESSION_USER') = ename
```

11

Administering and Using Trusted Stored Program Units

You can use trusted stored program units to enhance system security.

- [About Trusted Stored Program Units](#)
Oracle Database stored procedures, functions, and packages are sets of PL/SQL statements stored in a database in compiled form.
- [How a Trusted Stored Program Unit Runs](#)
A trusted stored program unit runs using its own privileges, and the caller's labels.
- [Example: Trusted Stored Program Unit](#)
A trusted stored program unit with the `READ` privilege can read all unprotected data and all data protected by this policy.
- [Creating and Compiling Trusted Stored Program Units](#)
You can create and compile trusted stored program units for use in Oracle Label Security.
- [How Setting and Returning Label Information Works](#)
The `SA_UTL` package has functions to return information about current values of session security attributes using numeric label values.

11.1 About Trusted Stored Program Units

Oracle Database stored procedures, functions, and packages are sets of PL/SQL statements stored in a database in compiled form.

The single difference between functions and procedures is that functions return a value and procedures do not. Trusted stored program units are like any other stored program units in *Oracle Database*: the underlying logic is the same.

A *package* is a set of procedures and functions, together with the cursors and variables they use, stored as a unit. There are two parts to a package, the package specification and the package body. The package specification declares the external definition of the public procedures, functions, and variables that the package contains. The package body contains the actual text of the procedures and functions, as well as any private procedures and variables.

A *trusted stored program unit* is a stored procedure, function, or package that has been granted one or more Oracle Label Security privileges. Trusted stored program units are typically used to let users perform privileged operations in a controlled manner, or update data at several labels. This is the optimal approach to permit users to access data beyond their authorization.

Trusted stored program units provide fine-grained control over the use of privileges. Although you can potentially grant privileges to many users, the granting of privileges should be done with great discretion because it might violate the security policy established for your application. Rather than assigning privileges to users, you can identify any application operations requiring privileges, and implement them as trusted program units. When you grant privileges to these stored program units, you effectively restrict the Oracle Label Security privileges required by users. This approach employs the principle of *least privilege*.

For example, if a user with the label `CONFIDENTIAL` needs to insert data into `SENSITIVE` rows, then you can grant the `WRITEUP` privilege to a trusted stored program to which the user has access. In this way, the user can perform the task by means of the trusted stored program, while staying at the `CONFIDENTIAL` level.

The trusted program unit performs all the actions on behalf of the user. You can thus effectively encapsulate the security policy into a module that can be verified to make sure that it is valid.

11.2 How a Trusted Stored Program Unit Runs

A trusted stored program unit runs using its own privileges, and the caller's labels.

In this way, the trusted stored program unit can perform privileged operations on the set of rows constrained by the user's labels.

Oracle Database system and object privileges are intended to be bundled into roles. Users are then granted roles as necessary. By contrast, Oracle Label Security privileges can only be assigned to users or to stored program units. These trusted stored program units provide a more manageable mechanism than roles to control the use of Oracle Label Security privileges.

11.3 Example: Trusted Stored Program Unit

A trusted stored program unit with the `READ` privilege can read all unprotected data and all data protected by this policy.

Consider, for example, a user who is responsible for creating purchasing forecast reports. The user must perform a summation operation on the amount of all purchases. Regardless of whether or not user's own labels authorize access to the individual purchase orders. The syntax for creating the summation procedure in this example is as follows:

```
CREATE FUNCTION sum_purchases RETURN NUMBER IS
    psum NUMBER;
BEGIN
    SELECT SUM(amount) INTO psum
    FROM purchase_orders;
RETURN psum;
END sum_purchases;
```

In this way, the program unit can gather information the end user is not able to gather, and can make it available by means of a summation.

Note that to run `SUM_PURCHASES`, the user would need to be granted the standard Oracle Database `EXECUTE` object privilege upon this procedure.

Related Topics

- [Access Controls and Privileges](#)
Oracle provides access controls and privileges that determine the *type* of access users can have to labeled rows.

11.4 Creating and Compiling Trusted Stored Program Units

You can create and compile trusted stored program units for use in Oracle Label Security.

- [Creation of Trusted Stored Program Units](#)
You can create a trusted stored program unit in the same way that you create a standard procedure, function, or package.

- [Privileges for Trusted Stored Program Units](#)
An Oracle Label Security administrator can verify the correctness of a stored program unit code before granting the privileges to it.
- [Recompiling of Trusted Stored Program Units](#)
Recompiling a trusted stored program unit, either automatically or manually (using `ALTER PROCEDURE`), does not affect its Oracle Label Security privileges.
- [Re-creation of Trusted Stored Program Units](#)
Oracle Label Security privileges are revoked if you perform a `CREATE` or `REPLACE` operation on a trusted stored program unit.
- [Execution of Trusted Stored Program Units](#)
Under Oracle Label Security all the standard Oracle Database controls on procedure call (regarding access to tables and schemas) are still in force.

11.4.1 Creation of Trusted Stored Program Units

You can create a trusted stored program unit in the same way that you create a standard procedure, function, or package.

To do this, you can use the `CREATE PROCEDURE`, `CREATE FUNCTION`, or `CREATE PACKAGE` and `CREATE PACKAGE BODY` statements.

The program unit becomes trusted when you grant it Oracle Label Security privileges.



See Also:

Oracle Database SQL Language Reference

11.4.2 Privileges for Trusted Stored Program Units

An Oracle Label Security administrator can verify the correctness of a stored program unit code before granting the privileges to it.

Typically another user, such as a developer, creates the stored program unit. Whenever the trusted stored program unit is re-created or replaced, Oracle Label security removes its privileges. The Oracle Label Security administrator must then verify the code again and grant the privileges once again.

The Oracle Label Security administrator should review the program unit code carefully and evaluate the privileges that are to be granted to it. For example, procedures in trusted packages should not perform privileged database operations and then write result or status information into a public variable of the package. In this way, you can make sure that no violations of your site's Oracle Label Security policy can occur.

Related Topics

- [SA_USER_ADMIN.SET_PROG_PRIVS](#)
The `SA_USER_ADMIN.SET_PROG_PRIVS` procedure sets policy-specific privileges for program units.

11.4.3 Recompiling of Trusted Stored Program Units

Recompiling a trusted stored program unit, either automatically or manually (using `ALTER PROCEDURE`), does not affect its Oracle Label Security privileges.

You must, however, grant the `EXECUTE` privilege on the program unit again after recompiling.

11.4.4 Re-creation of Trusted Stored Program Units

Oracle Label Security privileges are revoked if you perform a `CREATE` or `REPLACE` operation on a trusted stored program unit.

This limits the potential for misuse of a procedure's Oracle Label Security privileges.

Note that the procedure, function, or package can still run even if the Oracle Label Security privileges have been removed.

If you re-create a procedure, function, or package, then you should carefully review its text. When you are certain that the re-created program unit does not violate your site's Oracle Label Security policy, you can then grant it the required privileges again.

In a development environment where trusted stored program units must frequently be replaced (for example, during the first few months of a live system), it is advisable to create a script that can grant the proper Oracle Label Security privileges, as required.

11.4.5 Execution of Trusted Stored Program Units

Under Oracle Label Security all the standard Oracle Database controls on procedure call (regarding access to tables and schemas) are still in force.

Oracle Label Security complements these security mechanisms by controlling access to rows.

When a trusted stored program unit is carried out, the policy privileges in force are a union of the invoking user's privileges and the program unit's privileges. Whether a trusted stored program unit calls another trusted program unit or a non-trusted program unit, the program unit called runs with the same privileges as the original program unit.

If a sequence of non-trusted and trusted stored program units is carried out, the first trusted program unit will determine the privileges of the entire calling sequence from that point on. Consider the following sequence:

- Procedure A (non-trusted)
- Procedure B with `WRITEUP`
- Procedure C with `WRITEDOWN`
- Procedure D (non-trusted)

Here, Procedures B, C, and D all runs with the `WRITEUP` privilege, because B was the first trusted procedure in the sequence. When the sequence ends, the privilege pertaining to Procedure B is no longer in force for subsequent procedures.



Note:

Unhandled exceptions raised in trusted program units are caught by Oracle Label Security. This means that error messages may not be displayed to the user. For this reason, you should always thoroughly test and debug any program units before granting them privileges.

11.5 How Setting and Returning Label Information Works

The `SA_UTL` package has functions to return information about current values of session security attributes using numeric label values.

Although these functions can be used in program units that are not trusted, they are primarily for use in trusted stored program units.

Note that these are public functions; you do not need the `policy_DBA` role to use them. In addition, each of the functions has a parallel `SA_SESSION` function that returns the same labels in character string format.

Related Topics

- [Duties of Oracle Label Security Administrators](#)
Oracle Label Security administrators have a set of package- and role-based privileges.

12

Using Oracle Label Security with a Distributed Database

You should understand the special considerations for using Oracle Label Security in a distributed configuration.

- [About the Oracle Label Security Distributed Configuration](#)
In a network configuration that supports distributed databases, multiple Oracle Database (or other) servers can run on the same or different operating systems.
- [How Connections to a Remote Database Under Oracle Label Security Work](#)
Distributed databases act in the standard way with Oracle Label Security: the local user ends up connected as a particular remote user.
- [Session Labels and Row Labels in Remote Sessions](#)
When connecting remotely, you can directly control the session label and row label in effect when you establish the connection.
- [Labels in a Distributed Environment](#)
You should use the same label component definitions and label tags on any database that is to be protected by the policy.
- [Oracle Label Security Policies in a Distributed Environment](#)
Oracle Label Security supports all standard Oracle Database distributed configurations.
- [Replication with Oracle Label Security](#)
You should understand how to use the replication option with tables protected by Oracle Label Security policies.

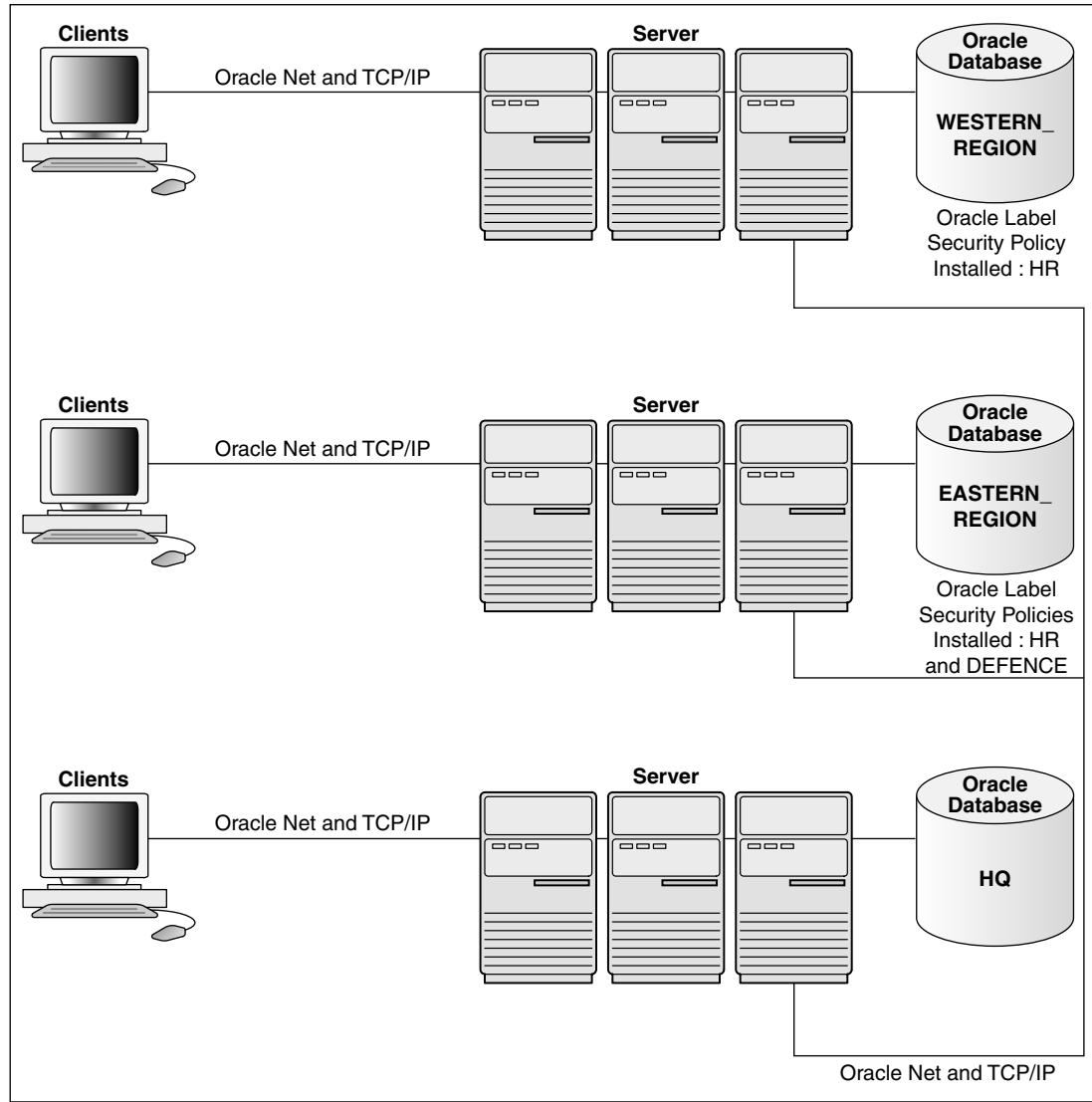
12.1 About the Oracle Label Security Distributed Configuration

In a network configuration that supports distributed databases, multiple Oracle Database (or other) servers can run on the same or different operating systems.

Each cooperative server in a distributed system communicates with other clients and servers over a network.

[Figure 12-1](#) illustrates a distributed database that includes clients and servers with and without Oracle Label Security. As described in this chapter, if you establish database links from the `WESTERN_REGION` database to the `EASTERN_REGION` database, then you can access data if your user ID on `EASTERN_REGION` is authorized to see it, even if locally (on `WESTERN_REGION`) you do not have this access.

Figure 12-1 Using Oracle Label Security with a Distributed Database



12.2 How Connections to a Remote Database Under Oracle Label Security Work

Distributed databases act in the standard way with Oracle Label Security: the local user ends up connected as a particular remote user.

Oracle Label Security protects the labeled data, whether you connect locally or remotely. If the remote user has the proper labels, then you can access the data. If not, then you cannot access the data.

The database link sets up the connection to the remote database and identifies the user who will be associated with the remote session. Your Oracle Label Security authorizations on the remote database are based on those of the remote user identified in the database link.

For example, local user `JANE` might connect as remote user `AUSTEN`, in the database referenced by the connect string `sales`, as follows:

```
CREATE DATABASE LINK sales
CONNECT TO austen IDENTIFIED BY pride
USING 'sales'
```

When JANE connects, their authorizations are based on the labels and privileges of remote user AUSTEN, because AUSTEN is the user identified in the database link. When JANE makes the first reference to the remote database, the remote session is actually established. For example, the remote session would be created if JANE enters:

```
SELECT * FROM emp@sales
```

You need not be an Oracle Label Security policy user in the local database. If you connect as a policy user on the remote database, you can access protected data.

12.3 Session Labels and Row Labels in Remote Sessions

When connecting remotely, you can directly control the session label and row label in effect when you establish the connection.

When you connect, Oracle Label Security passes these values (for all policies) over to the remote database. Notice that:

- The local session label and row label are used as the default for the remote session, if they are valid for the remote user.
- The remote session is constrained by the minimum and maximum authorizations of the remote user.
- Although the local user's session labels are passed to the remote database, the local user's privileges are not passed. The privileges for the remote session are those associated with the remote user.

Consider a local user, Diana, with a maximum level of HS, and a session level of S. On the remote database, the remote user identified in the database link has a maximum level of S.

- If Diana's session label is S when the database link is established, then the S label is passed over. This is a valid label. Diana can connect and read SENSITIVE data.
- If Diana's session label is HS when the database link is established, then the HS level is passed across, but it is not valid for the remote user. Diana will pick up the remote user's default label (S).

Be aware of the label at which you are running the first time you connect to the remote database. The first time you reference a database link, your local session labels are sent across to the remote system when a connection is made. Later, you can change the label, but to do so, you must run the SA_SESSION.SET_LABEL procedure on the remote database.

Diana can connect at level HS, set the label to S, and then perform a remote access. Connection is implicitly made when the database link is established. Diana's default label is S on the remote database.

On the local database, Diana can set their session label to their maximum level of HS, but if the label of the remote user is set to S, then Diana can only retrieve S data from the remote database. If Diana performs a distributed query, then they will get HS data from the local database, and S data from the remote database.

12.4 Labels in a Distributed Environment

You should use the same label component definitions and label tags on any database that is to be protected by the policy.

- [Label Tags in a Distributed Environment](#)
In a distributed environment, you may choose to use the same label tags across multiple databases.
- [Numeric Form of Label Components in a Distributed Environment](#)
In a distributed environment, the same relative ranking of the numeric form of the level component ensures that the labels are properly sorted.

12.4.1 Label Tags in a Distributed Environment

In a distributed environment, you may choose to use the same label tags across multiple databases.

However, if you choose *not* to use the same tags across multiple databases, then you should retrieve the character form of the label when performing remote operations. This will ensure that the labels are consistent.

In the following example, the character string representation of the label string is the same. However, the label tag does not match. If the retrieved label tag has a value of 11 on the `WESTERN_REGION` database but a tag of 2001 on the `EASTERN_REGION` database, then the tags have no meaning. Serious consequences can result.

Figure 12-2 Label Tags in a Distributed Database

EASTERN_REGION		WESTERN_REGION	
Label	Label Tag	Label	Label Tag
S:A	3001	S:A	11
C:A	2001	C:A	6
U	10	U	5

When retrieving labels from a remote system, you should return the character string representation (rather than the numeric label tag), unless you are using the same numeric labels on both databases.

If you allow Oracle Label Security to automatically generate labels on different databases, then the label tags will not be identical. Character strings will have meaning, but the numeric values will not, unless you have predefined labels with the same label tags on both instances.

To avoid the complexities of label tags, you can convert labels to strings on retrieval (using `LABEL_TO_CHAR`) and use `CHAR_TO_LABEL` when you store labels. Operations will succeed as long as the component names are the same.

12.4.2 Numeric Form of Label Components in a Distributed Environment

In a distributed environment, the same relative ranking of the numeric form of the level component ensures that the labels are properly sorted.

In the following example, the levels in the two databases are effectively the same. Although the numeric form is different, the relative ranking of the levels numeric form is the same. As long as the relative order of the components is the same, the labels are perceived as identical.

Figure 12-3 Label Components in a Distributed Database

EASTERN_REGION		WESTERN_REGION	
Level	Numeric Form	Level	Numeric Form
S	30	S	6
C	20	C	5
U	10	U	4

12.5 Oracle Label Security Policies in a Distributed Environment

Oracle Label Security supports all standard Oracle Database distributed configurations.

Whether or not you can access protected data depends on the policies installed in each distributed database.

Be sure to take into account the relationships between databases in a distributed environment:

- If the same application runs on two databases and you want them to have the same protection, then you must apply the same Oracle Label Security policy to both the local and the remote databases.
- If the local and remote databases have a policy in common, then your local session label and row label will override the default labels for the remote user.
- If the remote database has a different policy than the local database, then the remote policy can restrict access to the data independent of your local policies. On the other hand, when you make a connection as a remote user who has authorization on the remote policy, you can access any data to which the remote user has access to, regardless of your local authorizations.

If the remote database has no policy applied to it, you can access its data just as you would with a standard distributed database.

Consider a situation in which three databases exist, with different Oracle Label Security policies in force:

Database 1 has Policy A and Policy B
 Database 2 has Policy A
 Database 3 had Policy C

Users authorized for Policy A can obtain protected data from Database 1 and Database 2. If the remote user is authorized for Policy C, then this user can obtain data from Database 3 as well.

12.6 Replication with Oracle Label Security

You should understand how to use the replication option with tables protected by Oracle Label Security policies.

- [About Replication Under Oracle Label Security](#)
 You can replicate data in Oracle Label Security.

- [Contents of a Materialized View](#)
Oracle Label Security can create materialized views.
- [Requirements for Creating Materialized Views Under Oracle Label Security](#)
The requirements for creating a materialized view depend on the type of materialized view you are creating.
- [How to Refresh Materialized Views](#)
If the contents or definition of a master table changes, then you should refresh the materialized view.

12.6.1 About Replication Under Oracle Label Security

You can replicate data in Oracle Label Security.

- [Replication Functionality Supported by Oracle Label Security](#)
Oracle Label Security supports replication using read-only materialized views (snapshots).
- [Row-Level Security Restriction on Replication Under Oracle Label Security](#)
An Oracle Label Security policy applies Row Level Security (RLS) to a table if `READ_CONTROL` is specified as one of the policy options.

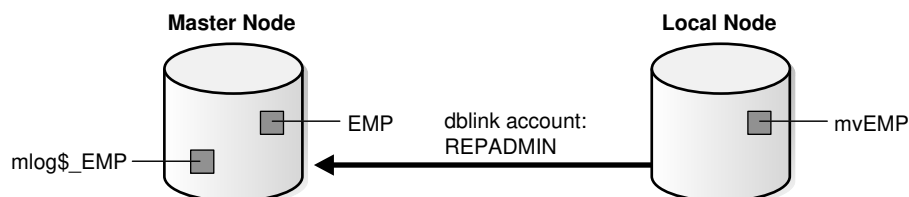
12.6.1.1 Replication Functionality Supported by Oracle Label Security

Oracle Label Security supports replication using read-only materialized views (snapshots).

Oracle Database uses materialized views for replicating data. A *materialized view* is a local copy of a local or remote master table that reflects a recent state of the master table.

As illustrated in the following figure, a master table is a table you wish to replicate, on a node that you designate as the master node. Using a `dblink` account, you can create a materialized view of the table in a different database. (This can also be done in the same database, and on the same system.) You can select rows from the remote master table, and copy them into the local materialized view. Here, `mvEMP` represents the materialized view of table `EMP`, and `mlog$_EMP` represents the materialized view log.

Figure 12-4 Use of Materialized Views for Replication



In a distributed environment, a materialized view alleviates query traffic over the network and increases data availability when a node is not available.

12.6.1.2 Row-Level Security Restriction on Replication Under Oracle Label Security

An Oracle Label Security policy applies Row Level Security (RLS) to a table if `READ_CONTROL` is specified as one of the policy options.

Problems occur if *both* of the following conditions are true:

- The Oracle Label Security policy is applied to any table relevant to replication (such as the master table, materialized view, or materialized view log), and
- The policy returns a predicate in the `WHERE` clause of `SELECT` statements.

To avoid the additional predicate (and therefore avoid this problem), the users involved in a replication environment should be given the necessary Oracle Label Security privileges. To be specific, the designated users in the database link (such as `REPADMIN` and the materialized view owner) must have the `READ` or the `FULL` privilege. As a result, the queries used to perform the replication will not be modified by RLS.

12.6.2 Contents of a Materialized View

Oracle Label Security can create materialized views.

- [How Materialized View Contents Are Determined](#)
Oracle Label Security performs a set steps when creating materialized views.
- [Complete Materialized Views](#)
Oracle Label Security supports complete materialized views.
- [Partial Materialized Views](#)
A partial materialized view is created when you specify a `WHERE` clause in the materialized view definition.

12.6.2.1 How Materialized View Contents Are Determined

Oracle Label Security performs a set steps when creating materialized views.

The following steps determine the contents of the view:

1. It reads the definition of the master table in the remote database.
2. It reads the rows in the master table that meet the conditions defined in the materialized view definition.
3. It writes these rows to the materialized view in the local database.

Because Oracle Label Security writes only those rows to which you have write access in the local database, the contents of the materialized view vary according to:

- The policy options in effect
- The privileges you have defined in the local database
- The session label

12.6.2.2 Complete Materialized Views

Oracle Label Security supports complete materialized views.

If you read all of the rows in the master table and have write access in the local database to each label in the materialized view, then the result is a complete materialized view of the master table. To ensure that the materialized view is complete, you should have read access to all of the data in the master table and write access in the local database to all labels at which data is stored in the master table.

**Note:**

Never revoke privileges that you granted when you created the materialized view. If you do, then you may not be able to perform a replication refresh.

12.6.2.3 Partial Materialized Views

A partial materialized view is created when you specify a `WHERE` clause in the materialized view definition.

A partial materialized view is a convenient way to pass subsets of data to a remote database.

To create a partial materialized view, a user must have write access to all the rows being replicated. You can find the currently granted privileges for a user by querying the `DBA_SA_USER_PRIVS` data dictionary view.

12.6.3 Requirements for Creating Materialized Views Under Oracle Label Security

The requirements for creating a materialized view depend on the type of materialized view you are creating.

- [Requirements for a Replication Administrator](#)
Requirements for a replication administrator, typically using a `REPADMIN` account, vary depending on the configuration.
- [Requirements for the Owner of the Materialized View](#)
The privileges that belong to the owner of the materialized view are used during the refresh of the materialized view.
- [Requirements for Creating Partial Multilevel Materialized Views](#)
A partial materialized view can include only some of the rows in a remote master table that is protected by Oracle Label Security.
- [Requirements for Creating Complete Multilevel Materialized Views](#)
A complete materialized view can include every row in a remote master table that is protected by Oracle Label Security.

12.6.3.1 Requirements for a Replication Administrator

Requirements for a replication administrator, typically using a `REPADMIN` account, vary depending on the configuration.

In general, however, it should meet the following requirements:

- It must have the `FULL` Oracle Label Security privilege (mandatory for all configurations).
- It must have the `SELECT` privilege on the master table.
- It must be the account that establishes the database link from the remote node to the database containing the master table.

12.6.3.2 Requirements for the Owner of the Materialized View

The privileges that belong to the owner of the materialized view are used during the refresh of the materialized view.

If these privileges are not sufficient, then there are two options:

- The materialized view can be created in the `REPADMIN` account, or
- Additional privileges must be granted to the owner of the materialized view.

Consider, for example, the following materialized view created by user `SCOTT`:

```
CREATE MATERIALIZED VIEW mvemp as
SELECT *
FROM EMP@link_to_master
WHERE label_to_char(sa_label) = 'HS';
```

Here, `SCOTT` should have permission to insert records at the `HS` level in the local database. If Oracle Label Security policies are applied on the materialized view, then `SCOTT` must have the `FULL` privilege to avoid the RLS restriction.

Different configurations can be set up depending on whether Oracle Label Security policies are applied on the materialized view, what privileges are granted to the owner of the materialized view, and so on. If Oracle Label Security policies are applied to the materialized view, but `SCOTT` should not be granted the `FULL` privilege, then the `REPADMIN` account must be used to create the materialized view. `SCOTT` can then be granted the `SELECT` privilege on that table.

If no policies are applied to the materialized view, then the view can be created in `SCOTT`'s schema without any additional privileges. In this case, the materialized view should be created in such a way that a `WHERE` condition limits the records to those which `SCOTT` can read.

Finally, if `SCOTT` can be granted the `FULL` privilege, then the materialized view can be created in `SCOTT`'s schema, and Oracle Label Security policies can also be applied on the materialized view.

Note that the master table can have Oracle Label Security policies containing any set of policy options. If `SCOTT` has the `FULL` or the `READ` privilege, then he can select all rows, regardless of policy options.

12.6.3.3 Requirements for Creating Partial Multilevel Materialized Views

A partial materialized view can include only some of the rows in a remote master table that is protected by Oracle Label Security.

If the partial materialized view is used in a table that Oracle Label Security protects, then you should ensure that you have sufficient privileges to `WRITE` in the local database at every label retrieved by your query. You can find your currently granted privileges by querying the `ALL_SA_USER_PRIVS` data dictionary view.

12.6.3.4 Requirements for Creating Complete Multilevel Materialized Views

A complete materialized view can include every row in a remote master table that is protected by Oracle Label Security.

If the complete materialized view is used in a table that Oracle Label Security protects, then you must be able to have `WRITE` access in the local database at the labels of all of the rows

retrieved by the defined materialized view query. You can find your currently granted privileges by querying the `ALL_SA_USER_PRIVS` data dictionary view.

12.6.4 How to Refresh Materialized Views

If the contents or definition of a master table changes, then you should refresh the materialized view.

This ensures that the materialized view accurately reflects the contents of the master table.

To refresh a materialized view of a remote multilevel table, you must also have privileges to write in the local database at the labels of all of the rows that the materialized view query retrieves

WARNING:

A materialized view can potentially contain outdated rows if you refresh a partial or full materialized view but do not have `READ` access to all the rows in the master table, and consequently do not overwrite the rows in the original materialized view with the updated rows from the master table.

To ensure an accurate materialized view refresh, you should use job queues to refresh the views automatically. These processes must have sufficient privileges both to read all of the rows in the master table and to write those rows to the materialized view, ensuring that the view is completely refreshed. Remember that the privileges used by these processes are those of the materialized view owner.

See Also:

Oracle Database Data Warehousing Guide for information about job queues

13

Performing DBA Functions Under Oracle Label Security

Oracle Label Security supports the standard Oracle Database utilities, but certain restrictions apply, which may require extra steps to get the expected results.

- [Oracle Data Pump Export Use with Oracle Label Security](#)
Oracle Data Pump enables high-speed movement of data and metadata from one database to another.
- [Data Pump Import Use with Oracle Label Security](#)
Oracle Data Pump enables high-speed movement of data and metadata from one database to another.
- [SQL*Loader Use with Oracle Label Security](#)
SQL*Loader moves data from external files into tables in Oracle Database.
- [Performance Tips for Oracle Label Security](#)
You can achieve optimal performance with Oracle Label Security.
- [Creation of Additional Databases After Installation](#)
You can create and configure additional databases after you install Oracle Label Security.
- [Oracle Label Security Upgrades and Downgrades](#)
You should be aware of how to manage Oracle Label Security upgrades and downgrades.

13.1 Oracle Data Pump Export Use with Oracle Label Security

Oracle Data Pump enables high-speed movement of data and metadata from one database to another.

- [Full Database Export](#)
Starting with Oracle Database 12c, Oracle Label Security metadata in the `LBACSYS` schema can be included when doing a full database export and import operation.
- [Schema and Table-Level Export](#)
The Data Pump export utility functions in the standard way under Oracle Label Security.

13.1.1 Full Database Export

Starting with Oracle Database 12c, Oracle Label Security metadata in the `LBACSYS` schema can be included when doing a full database export and import operation.

The source database can be Oracle Database 11g release 2 (11.2.0.3), or higher, but the target database must be Oracle Database 12c or higher.

Before starting the Data Pump import on the target database, you must enable Oracle Label Security.

13.1.2 Schema and Table-Level Export

The Data Pump export utility functions in the standard way under Oracle Label Security.

There are, however, a few differences resulting from the enforcement of Oracle Label Security policies.

 **Note:**

You must have the `EXEMPT ACCESS POLICY` privilege in order to export all rows in the table, or else no rows are exported.

- For any tables protected by an Oracle Label Security policy, only rows with labels authorized for read access are exported. Unauthorized rows are not included in the export file. Consequently, to export all the data in protected tables, you must have a privilege (such as `FULL` or `READ`) that gives you complete access.
- SQL statements to reapply policies are exported along with tables and schemas that are exported. These statements are carried out during import to reapply policies with the same enforcement options as in the original database.
- The `HIDE` property is not exported. When protected tables are exported, the label columns in those tables are also exported (as numeric values). However, if a label column is hidden, then it is exported as a normal, unhidden column.
- The user must have `EXEMPT ACCESS POLICY` in order to export all rows in the table, or else no rows are exported.

13.2 Data Pump Import Use with Oracle Label Security

Oracle Data Pump enables high-speed movement of data and metadata from one database to another.

- [Full Database Import for the LBACSYS Schema Metadata](#)
Oracle Label Security metadata in the `LBACSYS` schema can be included when you perform a full database export and import operation.
- [Schema and Table Level Import](#)
You can use the Oracle Data Pump Import utility functions under Oracle Label Security.

13.2.1 Full Database Import for the LBACSYS Schema Metadata

Oracle Label Security metadata in the `LBACSYS` schema can be included when you perform a full database export and import operation.

The source database can be Oracle Database 11g release 2 (11.2.0.3), or higher, but the target database must be Oracle Database 12c release 1 (12.1) or higher.

Oracle Data Pump import utility, `impdp`, automatically imports Label Security metadata including policies, labels, user authorizations, schema and table policy enforcements. You must register and enable Oracle Label Security for the target database before beginning the import operation.

Related Topics

- [Checking if Oracle Label Security Has Been Registered and Enabled](#)
You can query the `DBA_OLS_STATUS` data dictionary view to find if Oracle Label Security has already been registered and enabled.

13.2.2 Schema and Table Level Import

You can use the Oracle Data Pump Import utility functions under Oracle Label Security.

- [Requirements for Import Under Oracle Label Security](#)
You can use the `impdp` under Oracle Label Security.
- [Definition of Data Labels for Import](#)
The label definitions at the time of import must include all the policy labels used in the export file.
- [Imports of Labeled Data Without Installing Oracle Label Security](#)
When data type for policy label columns is `NUMBER`, they can be imported into databases that do not have Oracle Label Security installed.
- [Imports of Unlabeled Data](#)
You can import unlabeled data into an existing table protected by an Oracle Label Security policy.
- [Importing Tables with Hidden Columns](#)
A hidden column is exported as a normal column, but the fact that it was hidden is lost.

13.2.2.1 Requirements for Import Under Oracle Label Security

You can use the `impdp` under Oracle Label Security.

To use the `impdp` under Oracle Label Security, you must prepare the import database and ensure that the import user has the proper authorizations.

- [Preparing the Import Database](#)
Before you can use the Import utility with Oracle Label Security, you must prepare the import database.
- [Verification of Import User Authorizations](#)
You must be authorized to run the import operation for labels required to insert data and labels in the export file.

13.2.2.1.1 Preparing the Import Database

Before you can use the Import utility with Oracle Label Security, you must prepare the import database.

1. Ensure that Oracle Label Security is enabled. See [Checking if Oracle Label Security Has Been Registered and Enabled](#).
2. Create any Oracle Label Security policies that protect the data to be imported.
Ensure that the policies use the same column names as in the export database.
3. Define in the import database all of the label components and individual labels used in tables being imported.
Ensure that the same tag values are assigned to the policy labels in each database. (Note that if you are importing into a database from which you exported, then the components are most likely already defined.)

13.2.2.1.2 Verification of Import User Authorizations

You must be authorized to run the import operation for labels required to insert data and labels in the export file.

Errors will be raised upon import if you do not meet the following requirements.

- To import tables or schemas with Label Security policies on them, you must have the `EXECUTE` privilege on the `SA_POLICY_ADMIN` package.

To ensure that all rows can be imported, you must have the `policy_DBA` role for all policies with data being imported. After each schema or table is imported, any policies from the export database are reapplied to the imported objects.

- You must also have the ability to write all rows that have been exported as follows:

Requirement 2:

- You can granted the `FULL` privilege or given sufficient authorization to write all labels contained in the import file.
- A user-defined labeling function can be applied to the table.

13.2.2.2 Definition of Data Labels for Import

The label definitions at the time of import must include all the policy labels used in the export file.

The `DBA_SA_LABELS` data dictionary view lists data labels. You can use the views `DBA_SA_LEVELS`, `DBA_SA_COMPARTMENTS`, `DBA_SA_GROUPS`, and in the export database to design SQL scripts that re-create the label components and labels for each policy in the import database. The following example shows how to generate a PL/SQL block that re-creates the individual labels for the `HR` policy:

```
set serveroutput on
BEGIN
  dbms_output.put_line('BEGIN');
  FOR l IN (SELECT label_tag, label
           FROM dba_sa_labels
           WHERE policy_name='HR'
           ORDER BY label_tag) LOOP
    dbms_output.put_line
      (' SA_LABEL_ADMIN.CREATE_LABEL(''HR'', ' ||
      l.label_tag || ', '' || l.label || '');');
  END LOOP;
  dbms_output.put_line ('END;');
  dbms_output.put_line ('/');
END;
/
```

If the individual labels do not exist in the import database with the same numeric values and the same character string representations as in the export database, then the label values in the imported tables will be meaningless. The numeric label value in the table may refer to a different character string representation, or it may be a label value that has not been defined at all in the import database.

If a user attempts to access rows containing invalid numeric labels, then the operation will fail.

13.2.2.3 Imports of Labeled Data Without Installing Oracle Label Security

When data type for policy label columns is `NUMBER`, they can be imported into databases that do not have Oracle Label Security installed.

In this case, the values in the policy label column are imported as numbers. Without the corresponding Oracle Label Security label definitions, the numbers will not reference any specific label.

Note that errors will be raised during the import if Oracle Label Security is not installed, because the SQL statements to reapply the policy to the imported tables and schemas will fail.

13.2.2.4 Imports of Unlabeled Data

You can import unlabeled data into an existing table protected by an Oracle Label Security policy.

Either the `LABEL_DEFAULT` option or a labeling function must be specified for each table being imported, so that the labels for the rows can be automatically initialized as they are inserted into the table.

13.2.2.5 Importing Tables with Hidden Columns

A hidden column is exported as a normal column, but the fact that it was hidden is lost.

If you want to preserve the hidden property of the label column, then you must first create the table in the import database.

1. Before you perform the import, create the table and apply the policy with the `HIDE` option. This adds the policy label column to the table as a hidden column.
2. Remove the policy from the table, so that the enforcement options specified in the export file can be reapplied to the table during the import operation.
3. Perform the import with `IGNORE=Y`. Setting the `IGNORE` parameter to `Y` ignores errors during import.
4. Manually apply the policy to the table with the `HIDE` option.

13.3 SQL*Loader Use with Oracle Label Security

SQL*Loader moves data from external files into tables in Oracle Database.

- [Requirements for Using SQL*Loader Under Oracle Label Security](#)
You can use SQL*Loader with the conventional path to load data into a database protected by Oracle Label Security.
- [Oracle Label Security Input to SQL*Loader](#)
If the policy column for a table is hidden, then you must use the `HIDDEN` keyword to convey this information to SQL*Loader.

13.3.1 Requirements for Using SQL*Loader Under Oracle Label Security

You can use SQL*Loader with the conventional path to load data into a database protected by Oracle Label Security.

Because SQL*Loader performs `INSERT` operations, all of the standard requirements apply when using SQL*Loader on tables protected by Oracle Label Security policies.

13.3.2 Oracle Label Security Input to SQL*Loader

If the policy column for a table is hidden, then you must use the `HIDDEN` keyword to convey this information to SQL*Loader.

To specify row labels in the input file, you must include the policy label column in the `INTO TABLE` clause in the control file.

To load policy labels along with the data for each row, you can specify the `CHAR_TO_LABEL` function or the `TO_DATA_LABEL` function in the SQL*Loader control file.

Table 13-1 shows the variations that you can use when you load Oracle Label Security data with SQL*Loader.

Table 13-1 Input Choices for Oracle Label Security Input to SQL*Loader

Form of Data	Explanation of Results
<code>col1 hidden integer external</code>	Hidden column loaded with tag value of data directly from data file
<code>col2 hidden char(5) "func(:col2)"</code>	Hidden column loaded with character value of data from data file. <code>func()</code> used to translate between the character label and its tag value. Note: <code>func()</code> might be <code>char_to_label()</code> .
<code>col3 hidden "func(:col3)"</code>	Same as in <code>col2</code> , field type defaults to char
<code>col4 hidden expression "func(:col4)"</code>	Hidden column not mapped to input data. <code>func()</code> will be called to provide the label value. This could be a user function.

For example, the following is a valid `INTO TABLE` clause in a control file that is loading data into the `DEPT` table:

```
INTO TABLE dept
(hr_label HIDDEN POSITION (1:22) CHAR "CHAR_TO_LABEL('HR',:hr_label)",
deptno    POSITION (23:26) INTEGER EXTERNAL,
dname     POSITION (27:40) CHAR,
loc       POSITION(41,54) CHAR)
```

The following could be an entry in the data file specified by this control file:

```
HS:FN                231 ACCOUNTING REDWOOD SHORES
```

13.4 Performance Tips for Oracle Label Security

You can achieve optimal performance with Oracle Label Security.

- [Use of ANALYZE to Improve Oracle Label Security Performance](#)
You can run the `ANALYZE` statement on the Oracle Label Security data dictionary tables in the `LBACSYS` schema.
- [Creation of Indexes on the Policy Label Column](#)
Creating the appropriate type of index on the policy label column improves the performance of user-raised queries on protected tables.
- [Label Tag Strategy Plan to Enhance Performance](#)
For optimal performance, you can plan a strategy for assigning values to label tags.
- [Partitioned Data Based on Numeric Label Tags](#)
Using a numeric ordering strategy with the numeric label tags applied to the labels can a basis for Oracle Database data partitioning.

13.4.1 Use of ANALYZE to Improve Oracle Label Security Performance

You can run the `ANALYZE` statement on the Oracle Label Security data dictionary tables in the `LBACSYS` schema.

This enables the cost-based optimizer to improve execution plans on queries, which improves Oracle Label Security performance.

Running `ANALYZE` on application tables improves the application SQL performance.



See Also:

Oracle Database SQL Language Reference for the `ANALYZE` syntax

13.4.2 Creation of Indexes on the Policy Label Column

Creating the appropriate type of index on the policy label column improves the performance of user-raised queries on protected tables.

If you have applied an Oracle Label Security policy on a database table in a particular schema, then you should compare the number of different labels to the amount of data. Based on this information, you can decide which type of index to create on the policy label column.

- If the cardinality of data in the policy label column (that is, the number of labels compared to the number of rows) is low, then consider creating a bitmapped index.
- If the cardinality of data in the policy label column is high, then consider creating a B-tree index.

Consider the following case, in which the `EMP` table is protected by an Oracle Label Security policy with the `READ_CONTROL` enforcement option set, and `HR_LABEL` is the name of the policy label column. A user raises the following query:

```
SELECT COUNT (*) FROM SCOTT.EMP;
```

In this situation, Oracle Label Security adds a predicate based on the label column. For example:

```
SELECT COUNT (*) FROM SCOTT.EMP
WHERE hr_label=100;
```

In this way, Oracle Label Security uses the security label to restrict the rows that are processed, based on the user's authorizations. To improve performance of this query, you could create an index on the `HR_LABEL` column.

Consider a more complex query (once again, with `READ_CONTROL` applied to the `EMP` table):

```
SELECT COUNT (*) FROM SCOTT.EMP
WHERE deptno=10
```

Again, Oracle Label Security adds a predicate based on the label column:

```
SELECT COUNT (*) FROM SCOTT.EMP
WHERE deptno=10
AND hr_label=100;
```

In this case, you might want to create a composite index based on the `DEPTNO` and `HR_LABEL` columns, to improve application performance.

13.4.3 Label Tag Strategy Plan to Enhance Performance

For optimal performance, you can plan a strategy for assigning values to label tags.

In general, it is best to assign higher numeric values to labels with higher sensitivity levels.

This is because, typically, many more users can see data at comparatively low levels and fewer users at higher levels can see many levels of data.

In addition, with `READ_CONTROL` set, Oracle Label Security generates a predicate that uses a `BETWEEN` clause to restrict the rows to be processed by the query. As illustrated in the following example, if the higher-sensitivity labels do not have a higher label tag than the lower-sensitivity labels, then the query will potentially examine a larger set of rows. This will affect performance.

Table 13-2 shows a set of label tags assigned as follows:

Table 13-2 Label Tag Performance Example: Correct Values

Label	Label Tag
TS:A,B	100
S:A	50
S	20
U:A	10

Here, a user whose maximum authorization is S:A can potentially access data at labels S:A, S, and U:A. Consider what happens when this user raises the following query:

```
SELECT COUNT (*) FROM SCOTT.EMP
```

Oracle Label Security adds a predicate that includes a `BETWEEN` clause (based on the maximum and minimum authorizations) to restrict the set of rows this user can see:

```
SELECT COUNT (*) FROM SCOTT.EMP
WHERE hr_label BETWEEN 10 AND 50;
```

Performance improves, because the query examines only a subset of data based on the user's authorizations. It does not fruitlessly process rows that the user is not authorized to access.

Table 13-3 shows how unnecessary work is performed if the tag values were assigned as follows:

Table 13-3 Label Tag Performance Example: Incorrect Values

Label	Label Tag
TS:A,B	50
S:A	100
S	20
U:A	10

In this case, the user with S:A authorization can see only some of the labels between 100 and 10. Although the user cannot see TS:A,B labels (that is, rows with a label tag of 50). A query would nonetheless pick up and process these rows, even though the user ultimately will not have access to them.

13.4.4 Partitioned Data Based on Numeric Label Tags

Using a numeric ordering strategy with the numeric label tags applied to the labels can a basis for Oracle Database data partitioning.

Depending on the application, partitioning data based on label values may or may not be useful. Consider, for example, a business-hosting CRM application to which many companies subscribe. In the same EMP table, there might be rows (and labels) for Subscriber 1 and Subscriber 2. That is, information for both companies can be stored in the same table, as long as it is labeled differently. In this case, employees of Subscriber 1 will never need to access data for Subscriber 2, so it might make sense to partition based on label. You could put rows for Subscriber 1 in one partition, and rows for Subscriber2 in a different partition. When a query is raised, it will access only one or the other partition, depending on the label. Performance improves because partitions that are not relevant are not examined by the query.

The following example shows this is done. It places labels in the 2000 series on one partition, labels in the 3000 series on another partition, and labels in the 4000 series on a third partition.

```
CREATE TABLE EMPLOYEE (
    EMPNO NUMBER(10) CONSTRAINT PK_EMPLOYEE PRIMARY KEY,
    ENAME VARCHAR2(10),
    JOB VARCHAR2(9),
    MGR NUMBER(4),
    HIREDATE DATE,
    SAL NUMBER(7,2),
    COMM NUMBER(7,2),
    DEPTNO NUMBER(4),
    HR_LABEL NUMBER(10))
    TABLESPACE PERF_DATA
    STORAGE (initial 2M
    NEXT 1M
    MINEXTENTS 1
    MAXEXTENTS unlimited)
    PARTITION BY RANGE (hr_label)
    (partition sx1 VALUES LESS THAN (2000) NOLOGGING,
    partition sx2 VALUES LESS THAN (3000),
    partition sx3 VALUES LESS THAN (4000)
);
```

13.5 Creation of Additional Databases After Installation

You can create and configure additional databases after you install Oracle Label Security.

- [About the Creation of Additional Databases After Installation](#)
When you install Oracle Database Enterprise Edition and Oracle Label Security, an initial Oracle database is created.
- [Creating Additional Databases When the Label Security Schema Is in the Seed](#)
You can configure Oracle Label Security if the database was installed with the label security schema is in the seed database.
- [Creating Additional Databases with the Custom Installation Option](#)
You can configure Oracle Label Security after a custom database installation.

13.5.1 About the Creation of Additional Databases After Installation

When you install Oracle Database Enterprise Edition and Oracle Label Security, an initial Oracle database is created.

If you want to create additional databases, then you should do this using the Database Configuration Assistant. Alternatively, you can create additional databases by following the steps listed in *Oracle Database Administrator's Guide*.

Each time you create a new database, you must install the Oracle Label Security data dictionary tables, views, and packages into it, and create the `LBACSYS` account.

For the first database, this is done automatically when you install Oracle Label Security, regardless of whether or not you choose the custom install. If you do not choose the custom install, then you are installing the database with the label security schema in the seed.

To create additional databases, there are different processes for configuring label security, depending on whether the first database was installed with the custom install or with the label security schema in the seed.

If you initially chose custom install, but did not install label security, you can install and configure label security using either process described in this section.

13.5.2 Creating Additional Databases When the Label Security Schema Is in the Seed

You can configure Oracle Label Security if the database was installed with the label security schema is in the seed database.

1. Select the Oracle Label Security option in DBCA.
2. Select the check box to configure Oracle Label Security.

13.5.3 Creating Additional Databases with the Custom Installation Option

You can configure Oracle Label Security after a custom database installation.

1. Connect to the Oracle Database instance as user `SYS`, using the `AS SYSDBA` syntax.
2. Run the script `$ORACLE_HOME/rdbms/admin/catols.sql`.

This script installs the label-based framework, data dictionary, data types, and packages. After the script is run, the `LBACSYS` account exists, with the password `LBACSYS`. All the Oracle Label Security packages exist under this account.

3. Change the default password of the `LBACSYS` user.
4. Change this password to a secure password.

13.6 Oracle Label Security Upgrades and Downgrades

You should be aware of how to manage Oracle Label Security upgrades and downgrades.

- [About Oracle Label Security Upgrades and Downgrades](#)
Oracle provides preprocess scripts that perform upgrade and downgrade operations.
- [Oracle Label Security Upgrades](#)
Oracle provides a preprocess script that you must run before you perform an upgrade.
- [Oracle Label Security Downgrades](#)
Oracle provides a preprocess script that you must run before you downgrade.

13.6.1 About Oracle Label Security Upgrades and Downgrades

Oracle provides preprocess scripts that perform upgrade and downgrade operations.

As a safety measure, before you run either the upgrade or downgrade preprocess script, Oracle recommends that you back up your audit records. To do this, you can archive the audit trail as described in *Oracle Database Security Guide*.

Before they run, the preprocess scripts check that there is enough space in the audit tablespace to copy all the audit records, and will exit without processing if there is not.

You may continue running your applications on the database while OLS preprocess scripts are running.

See Also:

Oracle Database Upgrade Guide for requirements for upgrading databases that use Oracle Label Security and Oracle Database Vault

13.6.2 Oracle Label Security Upgrades

Oracle provides a preprocess script that you must run before you perform an upgrade.

- [About Oracle Label Security Upgrades](#)
You must upgrade Oracle Label Security for pre-Oracle Database 12c release 1 (12.1) databases.
- [Running the Oracle Label Security Preprocess Script Before Upgrading](#)
You can run the Oracle Label Security preprocess script before upgrading.

13.6.2.1 About Oracle Label Security Upgrades

You must upgrade Oracle Label Security for pre-Oracle Database 12c release 1 (12.1) databases.

Note:

Running the `olspreupgrade.sql` script before upgrading is mandatory for upgrading databases earlier than Oracle Database 12c release (12.1) that use Oracle Label Security or Database Vault.

After you have upgraded to Oracle Database release 12c or later, you do not need to run the Oracle Label Security preprocessing script when you patch or upgrade the database.

Before performing the OLS upgrade process, you must run the Oracle Label Security preprocess upgrade script, `olspreupgrade.sql`, to process the `AUD$` table contents. The OLS upgrade moves the `AUD$` table from the `SYSTEM` schema to the `SYS` schema. The `olspreupgrade.sql` script is a preprocessing script required for this move. It creates a temporary table, `PREUPG_AUD$`, in the `SYS` schema and moves the `SYSTEM.AUD$` records to `SYS.PREUPG_AUD$`. The moved records can no longer be viewed through the `DBA_AUDIT_TRAIL` view, but can be viewed by directly accessing the `SYS.PREUPG_AUD$` table, until the upgrade completes. Once the upgrade completes, the `SYS.PREUPG_AUD$` table is permanently deleted and all audit records, can be viewed through the `DBA_AUDIT_TRAIL` view.

13.6.2.2 Running the Oracle Label Security Preprocess Script Before Upgrading

You can run the Oracle Label Security preprocess script before upgrading.

1. Copy the `ORACLE_HOME/rdbms/admin/olspreupgrade.sql` script from the newly installed Oracle home to the Oracle home of the database to be upgraded.

2. Connect to the database to be upgraded. At the system prompt, enter:

```
CONNECT SYS AS SYSDBA
Enter password password
```

3. Run the Oracle Label Security preprocess script:

```
@$ORACLE_HOME/rdbms/admin/olspreupgrade.sql
```

Note:

The upgrade status for the Oracle Label Security component will be marked `INVALID` if the Oracle Label Security preprocess script reports an error. If this happens, you must correct the errors and then rerun the upgrade process. See *Oracle Database Upgrade Guide* for more information about rerunning the upgrade process for Oracle Database.

13.6.3 Oracle Label Security Downgrades

Oracle provides a preprocess script that you must run before you downgrade.

- [About Oracle Label Security Downgrades](#)
You can downgrade from an Oracle Database 12c release 1 (12.1) or later database that uses Oracle Label Security or Oracle Database Vault.
- [Running the Oracle Label Security Preprocess Script Before Downgrading](#)
You must connect as `SYS` with the `SYSDBA` administrative privilege before running the Oracle Label Security preprocess script for a downgrade.

13.6.3.1 About Oracle Label Security Downgrades

You can downgrade from an Oracle Database 12c release 1 (12.1) or later database that uses Oracle Label Security or Oracle Database Vault.

To do this, you must run the OLS preprocessing script, `olspredowngrade.sql` to process the `AUD$` table contents. The OLS downgrade script moves the `AUD$` table from the `SYS` schema to the `SYSTEM` schema. The `olspredowngrade.sql` script is a processing script required in preparation for this move. It creates a temporary table, `PREDWG_AUD$`, in the `SYSTEM` schema and moves the `SYS.AUD$` records to `SYSTEM.PREDWG_AUD$`. The moved records can no longer be viewed through the `DBA_AUDIT_TRAIL` view, but you can view them by directly accessing the `SYSTEM.PREDWG_AUD$` table until the downgrade completes. Once the downgrade completes, the `SYSTEM.PREDWG_AUD$` table is permanently deleted. At this point, all audit records are available for viewing in the `DBA_AUDIT_TRAIL` data dictionary view.

13.6.3.2 Running the Oracle Label Security Preprocess Script Before Downgrading

You must connect as `SYS` with the `SYSDBA` administrative privilege before running the Oracle Label Security preprocess script for a downgrade.

1. Connect to the database to be downgraded. At the system prompt, enter:

```
CONNECT SYS AS SYSDBA  
Enter password password
```

2. Run the OLS preprocess downgrade script:

```
@$ORACLE_HOME/rdbms/admin/olspreddowngrade.sql
```

Releasability Using Inverse Groups

Oracle Label Security can implement the releasability using inverse groups.

- [About Inverse Groups and Releasability](#)
Inverse groups indicate *releasability* of information.
- [Comparison of Standard Groups and Inverse Groups](#)
Groups in Oracle Label Security identify organizations that own or access data.
- [How Inverse Groups Work](#)
Inverse groups are implemented in a special way and are organized to suit the needs of Oracle Label Security.
- [Algorithm for Read Access with Inverse Groups](#)
You should understand how the algorithm for read access with inverse groups works.
- [Algorithm for Write Access with Inverse Groups](#)
You should understand the algorithm for write access with inverse groups.
- [Algorithms for COMPACCESS Privilege with Inverse Groups](#)
Oracle provides algorithms for read and write access with inverse groups, for users who have `COMPACCESS` privilege.
- [Session Labels and Inverse Groups](#)
Inverse groups affect session labels and row labels.
- [Changes in Behavior of Procedures with Inverse Groups](#)
The `INVERSE_GROUP` option affects algorithms that determine the read and write access of the user to labeled data.
- [Dominance Rules for Labels with Inverse Groups](#)
You should understand how dominance rules work for Oracle labels and inverse groups.

14.1 About Inverse Groups and Releasability

Inverse groups indicate *releasability* of information.

They are used to mark the dissemination of data. When you add an inverse group to a data label, the data becomes less classified.

For example, a user with inverse groups UK and US cannot access data that only has inverse group UK. Adding US to that data makes it accessible to all users with the inverse groups UK and US.

When you assign releasabilities to a user, you mark the communication channel to the user. For data to flow across the communication channel, the data releasabilities must dominate the releasabilities assigned to the user. In other words, releasabilities assigned to a data record must contain all the releasabilities assigned to a user.

The advantage of releasabilities lies in their power to broadly disseminate information. Releasing data to the entire marketing organization becomes as simple as adding the Marketing releasability to the data record.

14.2 Comparison of Standard Groups and Inverse Groups

Groups in Oracle Label Security identify organizations that own or access data.

Like standard groups, inverse groups control the dissemination of information. However, the behavior of inverse groups differs from Oracle Label Security standard group behavior. By default, all policies created in Oracle Label Security use the standard group behavior.

The term, *releasabilities* is sometimes used to refer to the behavior provided by inverse groups. When you include inverse groups in a data label, the effect is similar to assigning label compartment authorizations to a user. When Oracle Label Security evaluates whether a user can view a row of data assigned to a label with inverse groups, it checks to see whether the data, not the user, has the appropriate group authorizations. It checks whether the data has *all* the inverse groups assigned to the user. With standard groups, by contrast, Oracle Label Security checks to see whether a user is authorized for *at least one* of the groups assigned to a row of data.

Consider a policy that contains three standard groups such as, Eastern, Western, and Southern. User1's label authorizations include the groups Eastern and Western. Assuming that User1 has been assigned the appropriate level and compartment authorizations in the policy, then:

- With standard Oracle Label Security groups, User1 can view *all* data records that have the group Eastern, or the group Western, or both Eastern and Western.
- With inverse groups, User1 can only view data records that have, *at a minimum, all* the groups assigned to the user, that is, both Eastern and Western. User1 *cannot* view records that have only the Eastern group, only the Western group, or that have no groups at all.

Table 14-1 shows all the rows that User1 can potentially access, given the type of group that is used in the policy.

Table 14-1 Access to Standard Groups and Inverse Groups

If row label contains groups:	User1 access with standard groups?	User1 access with inverse groups?
None	Y	N
Eastern	Y	N
Western	Y	N
Southern	N	N
Eastern, Western	Y	Y
Eastern, Southern	Y	N
Western, Southern	Y	N
Eastern, Western, Southern	Y	Y

Standard groups indicate *ownership* of information. In this way, all data pertaining to a certain department can have that department's group in the label. When you add a group to a data label, the data becomes more classified. For example, a user with no groups can access data that has no groups in its label. If you add the group US to the data label, the user can no longer access the data.

**See Also:**[Group Components](#)

14.3 How Inverse Groups Work

Inverse groups are implemented in a special way and are organized to suit the needs of Oracle Label Security.

- [Implementation of Inverse Groups with INVERSE_GROUP Enforcement](#)
When creating an Oracle Label Security policy, you can specify whether the policy can use inverse group functionality to implement releasability.
- [Inverse Groups and Label Components](#)
An Oracle Label Security policy created with the inverse group option uses the same policy label components as standard groups.
- [Computed Labels with Inverse Groups](#)
Inverse groups affect computed label values.
- [Inverse Groups and Hierarchical Structure](#)
Standard groups in Oracle Label Security are hierarchical, so that a group can be associated with a parent group.
- [Inverse Groups and User Privileges](#)
With inverse groups implemented, the meaning of user privileges remains the same.

14.3.1 Implementation of Inverse Groups with INVERSE_GROUP Enforcement

When creating an Oracle Label Security policy, you can specify whether the policy can use inverse group functionality to implement releasability.

To do this, you must specify `INVERSE_GROUP` as one of the `default_options` in the `CREATE_POLICY` statement.

The `INVERSE_GROUP` option can be set only at policy creation time. Once a policy is created, this option cannot be changed.

The `INVERSE_GROUP` option is thus policywide. It cannot be turned on or off when the policy is applied to a table or schema. If you attempt to do so, using the procedure `APPLY_TABLE_POLICY` or `APPLY_SCHEMA_POLICY`, then an error will be generated.

While other policy enforcement options can be dropped from a policy, the `INVERSE_GROUP` policy configuration option cannot be dropped once it is set. To remove the option, you must drop and then re-create the policy.

You can give individual users authorization for one or more inverse groups.

14.3.2 Inverse Groups and Label Components

An Oracle Label Security policy created with the inverse group option uses the same policy label components as standard groups.

These components include levels, compartments, and groups.

With inverse groups, however, the user's read groups and write groups have a different meaning and role in data access.

Consider the following policy example, with three levels, one compartment, and three groups:

Table 14-2 Policy Example

Policy Component	Abbreviation
Levels:	-
UNCLASSIFIED	UN
CONFIDENTIAL	CON
SECRET	SE
Compartments:	-
FINANCIAL	FIN
Groups:	-
EASTERN	EAS
WESTERN	WES
SOUTHERN	SOU

Two user labels have been assigned, CON:FIN and SE:FIN:EAS,WES

Two data labels have been assigned, CON:FIN:EAS and SE:FIN:EAS

User access to the data differs, depending on the type of group being used:

- If the policy uses standard groups, then:
 - The user with the label CON:FIN *cannot* read CON:FIN:EAS data.
 - The user with the label SE:FIN:EAS,WES *can* read SE:FIN:EAS data.
- If the policy has the INVERSE GROUPS policy enforcement option, then:
 - The user with the label CON: FIN *can* read CON:FIN:EAS data.
 - The user with the label SE:FIN:EAS,WES *cannot* read SE:FIN:EAS data.

14.3.3 Computed Labels with Inverse Groups

Inverse groups affect computed label values.

- [Computed Session Labels with Inverse Groups](#)
After the administrator assigns label authorizations to a user, Oracle Label Security automatically computes a number of labels.
- [Inverse Groups and Computed Max Read Groups and Max Write Groups](#)
Oracle Label Security provides different inverse groups to handle read and write operations.

14.3.3.1 Computed Session Labels with Inverse Groups

After the administrator assigns label authorizations to a user, Oracle Label Security automatically computes a number of labels.

With inverse groups, these labels are as follows:

Table 14-3 Computed Session Labels with Inverse Groups

Computed Label	Definition
Max Read Label	The user's maximum level combined with their authorized compartments and the minimum set of inverse groups that should be in the user label (session label)
Max Write Label	The user's maximum level combined with the compartments for which the user has been granted write access. Contains the maximum authorized inverse groups that can be set in any label. The user has write authorizations on all these inverse groups.
Min Write Label	The user's minimum level.
Default Read Label	The default level, combined with compartments and inverse groups that have been designated as default for the user.
Default Write Label	A subset of the default read label, containing the compartments and inverse groups for which the user has been granted write access. However the inverse groups component has no significance as it is the Max Write Groups that is always used for write access.
Default Row Label	The combination of components between the user's minimum write label and the maximum write label, which has been designated as the default for the data label for inserted data. The Inverse groups should be a superset of inverse groups in the default label and a subset of Max Write Groups.

Related Topics

- [Computed Session Labels](#)
Oracle Label Security automatically computes a number of labels based on the value of the session label.

14.3.3.2 Inverse Groups and Computed Max Read Groups and Max Write Groups

Oracle Label Security provides different inverse groups to handle read and write operations.

From the computed values in [Table 14-3](#), two sets of groups are identified for label evaluation of read and write access.

Table 14-4 Sets of Groups for Evaluating Read and Write Access

Sets of Groups	Meaning
Max Read Groups	Max Read Groups are the groups contained in the Max Read Label, identifying the <i>minimum</i> set of inverse groups that can be set in any user label.
Max Write Groups	Max Write Groups are the groups contained in the Max Write Label, identifying the <i>maximum</i> authorized inverse groups that can be set in any user label. This set of groups is checked at the time of write access, and also when setting session labels. Note that Max Write Groups is a superset of Max Read Groups.

As shown in [Table 14-5](#), for standard groups you can have `READ ONLY` and `READ/WRITE` authorizations; for inverse groups you can have `WRITE ONLY` and `READ/WRITE` authorizations.

Table 14-5 Read and Write Authorizations for Standard Groups and Inverse Groups

Type of Group	READ ONLY	READ/WRITE	WRITE ONLY
Standard Groups	The group is present only in Max Read Label, not in Max Write Label.	The group is present in both Max Read Label and Max Write Label.	Not supported
Inverse Groups	Not supported	The group is present in both Max Read Label and Max Write Label.	The group is present only in Max Write Label, not in Max Read Label.

Although Max Read Groups identifies the set of groups contained in the Max Read Label, this value represents the *minimum* set of inverse groups that can be set. For example:

Max Read Groups: `S:C1:G1,G2`

Max Write Groups: `S:C1:G1,G2,G3,G4,G5`

Here, the user can read data that contains at least the two groups listed in Max Read Groups.

Note that in standard groups, there can never be a situation in which there are more groups in the Max Write Label than in the Max Read Label.

14.3.4 Inverse Groups and Hierarchical Structure

Standard groups in Oracle Label Security are hierarchical, so that a group can be associated with a parent group.

For example, the `EASTERN` region can be the parent of two subordinate groups: `EAS_SALES`, and `EAS_HR`.

In a policy with standard groups, if the user label has the parent group, then it can access all data of the subordinate groups.

With inverse groups, parent-child relationships are not supported.

14.3.5 Inverse Groups and User Privileges

With inverse groups implemented, the meaning of user privileges remains the same.

When the user has no special privileges, then the read algorithm and the write algorithm are different for standard groups and inverse groups. The differences are described later, in [Algorithm for Read Access with Inverse Groups](#) and [Algorithm for Write Access with Inverse Groups](#).

The effect of inverse groups on the `COMPACCESS` privilege is described later, in [Algorithms for COMPACCESS Privilege with Inverse Groups](#).

Inverse groups have no impact upon the following user privileges:

- `PROFILE_ACCESS`
- `WRITEUP`
- `WRITEDOWN`

- WRITEACROSS

14.4 Algorithm for Read Access with Inverse Groups

You should understand how the algorithm for read access with inverse groups works.

To read data in a table with the `INVERSE GROUP` option in effect, the label evaluation process proceeds from levels to groups to compartments, as illustrated in [Figure 14-1](#). (Note that the current session label is the label being evaluated.)

1. The user's level must be greater than or equal to the level of data.
2. The user's label must include all the compartments assigned to the data
3. The groups in the data label must be a superset of the groups in the user label.

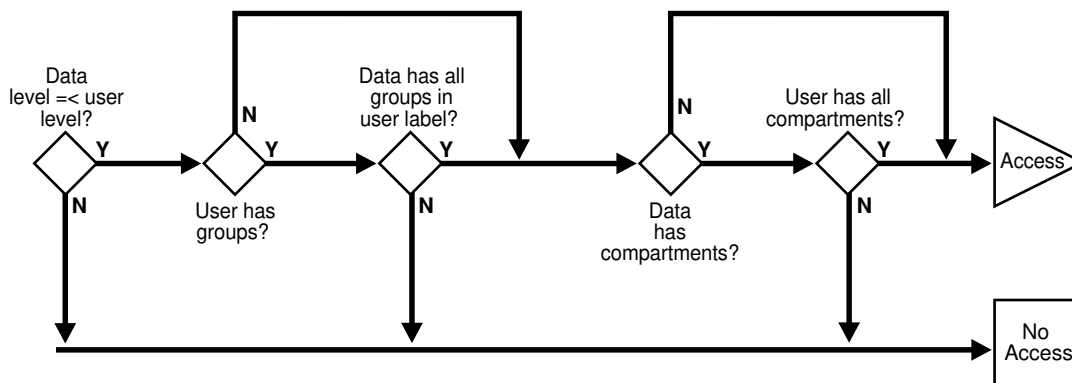
If the user's label passes these tests, then the user can access the data. If not, the user is denied access. Note that if the data label is null or invalid, then the user is denied access.



Note:

This flow diagram is true only when the user has no special privileges.

Figure 14-1 Read Access Label Evaluation with Inverse Groups



Related Topics

- [How Oracle Label Security Algorithm for Read Access Works](#)
The `READ_CONTROL` enforcement determines the ability to read data in a row.

14.5 Algorithm for Write Access with Inverse Groups

You should understand the algorithm for write access with inverse groups.

To write data in a table with the `INVERSE GROUP` option, the label evaluation process proceeds from levels to groups to compartments, as illustrated in [Figure 14-2](#). (Note that the current session label is the label being evaluated.)

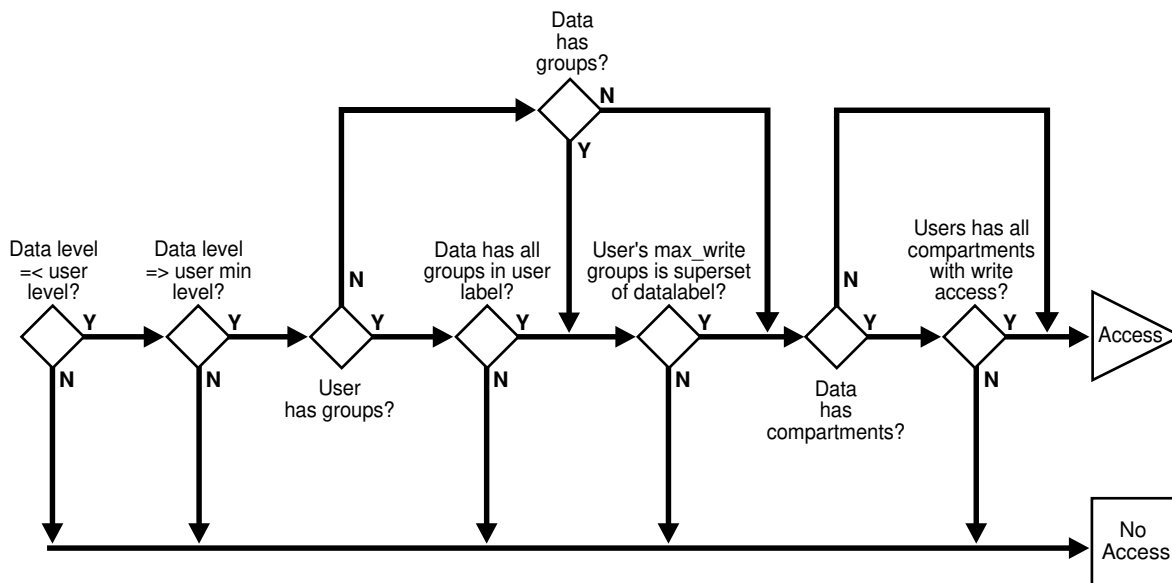
1. The level in the data label must be greater than or equal to the user's minimum level, and less than or equal to the user's session level.

2. One of the following conditions must be met:
The groups in the data label must be a superset of the groups in the user label.
or
The user has `READ` access privilege on the policy.
 3. The user's Max Write Groups must be a superset of the data label groups.
 4. The user label must have write access on all of the compartments in the data label.
- Note that if the data label is null or invalid, then the user is denied access.

 **Note:**

This flow diagram is true only when the user has no special privileges.

Figure 14-2 Write Access Label Evaluation with Inverse Groups



 **See Also:**

[How the Oracle Label Security Algorithm for Write Access Works](#)

14.6 Algorithms for COMPACCESS Privilege with Inverse Groups

Oracle provides algorithms for read and write access with inverse groups, for users who have `COMPACCESS` privilege.

The COMPACCESS privilege allows a user to access data based on the row's compartments, independent of the row's groups.

- When compartments exist and access to them is authorized, then the group authorization is bypassed.
- If a row has no compartments, then access is determined by the inverse group authorizations.

Figure 14-3 and Figure 14-4 show the label evaluation process for read access and write access for a user with the COMPACCESS privilege. If the data label is null or invalid, then the user is denied access.

(Note that the current session label is the label being evaluated.)

Figure 14-3 Read Access Label Evaluation: COMPACCESS Privilege and Inverse Groups

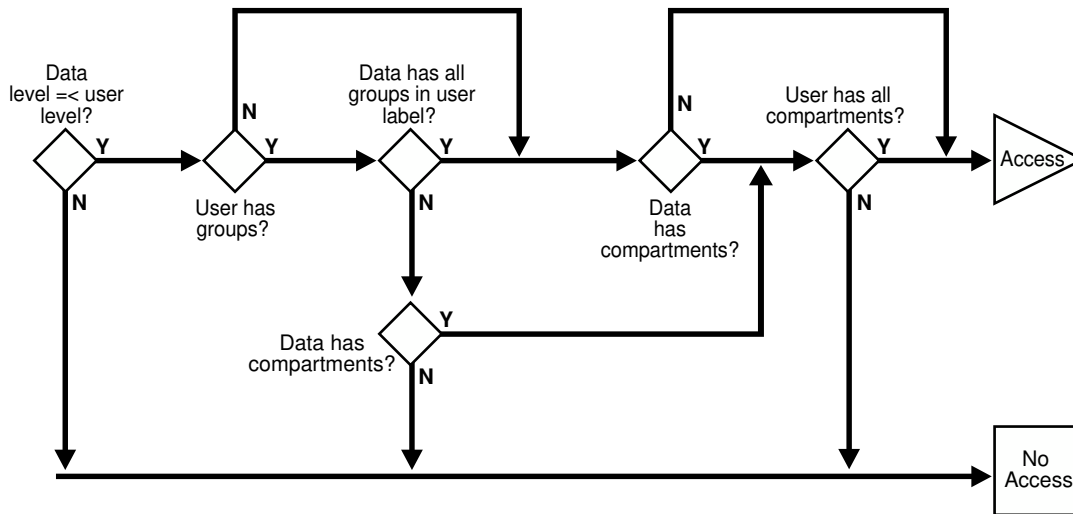
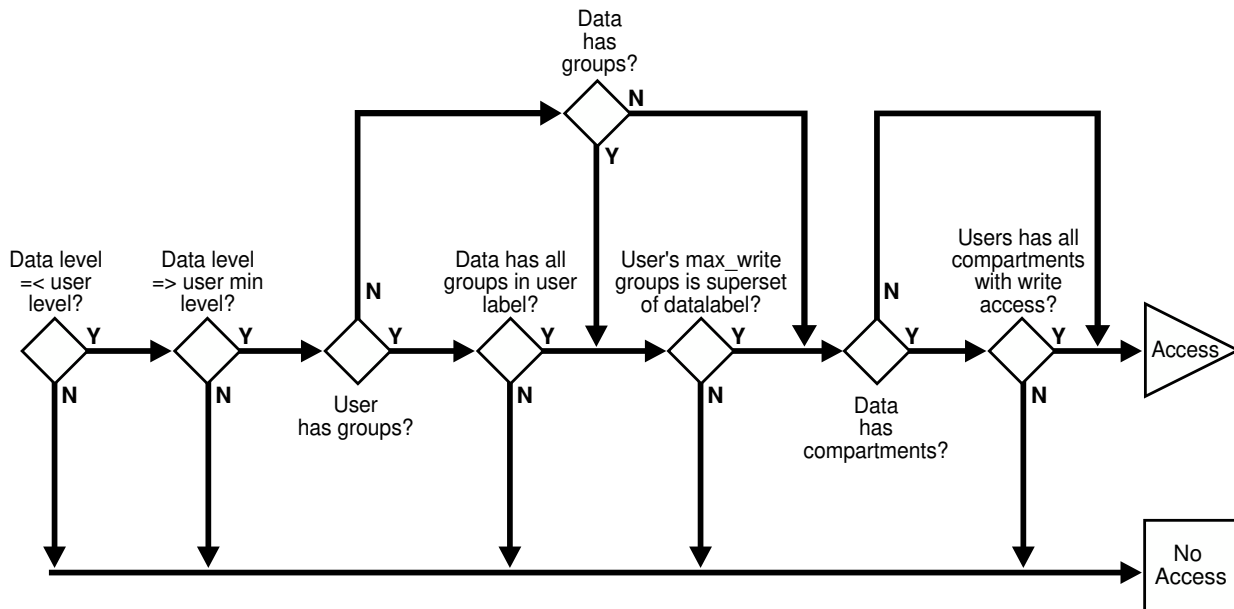


Figure 14-4 Write Access Label Evaluation: COMPACCESS Privilege and Inverse Groups



14.7 Session Labels and Inverse Groups

Inverse groups affect session labels and row labels.

- [Initial Session and Row Labels for Standard or Inverse Groups](#)
Oracle provides initial session and row labels for standard and inverse groups.
- [Setting Current Session or Row Labels for Standard or Inverse Groups](#)
You can set the current session or row labels for standard or inverse groups.
- [Examples of Session Labels and Inverse Groups](#)
Oracle provides examples of using inverse groups.

14.7.1 Initial Session and Row Labels for Standard or Inverse Groups

Oracle provides initial session and row labels for standard and inverse groups.

- [About the Initial Session and Row Labels for Standard or Inverse Groups](#)
The use of inverse groups affects the behavior of Oracle Label Security procedures that determine the session label.
- [Standard Groups: Rules for Changing Initial Session/Row Labels](#)
A user's default session label can be changed using `SA_USER_ADMIN.SET_DEFAULT_LABEL`.
- [Inverse Groups: Rules for Changing Initial Session/Row Labels](#)
The default session label can include groups in the authorized list if the new write label dominates the current default row label.

14.7.1.1 About the Initial Session and Row Labels for Standard or Inverse Groups

The use of inverse groups affects the behavior of Oracle Label Security procedures that determine the session label.

The `SA_USER_ADMIN.SET_DEFAULT_LABEL` and `SA_USER_ADMIN.SET_ROW_LABEL` procedures set the user's initial session label and row label, respectively, to the one specified.

14.7.1.2 Standard Groups: Rules for Changing Initial Session/Row Labels

A user's default session label can be changed using `SA_USER_ADMIN.SET_DEFAULT_LABEL`.

In the case of standard groups, the default session label can be set to include any groups in the authorized list, as long as the current default row label will still be dominated by the new write label. That is, the row label will have *the same or fewer standard groups* than the new write label.

The same rule applies for `SA_USER_ADMIN.SET_ROW_LABEL`.

14.7.1.3 Inverse Groups: Rules for Changing Initial Session/Row Labels

The default session label can include groups in the authorized list if the new write label dominates the current default row label.

That is, the row label will have *the same or more inverse groups* than the new write label. The same rule applies for `SA_USER_ADMIN.SET_ROW_LABEL`.

Related Topics

- [SA_USER_ADMIN.SET_DEFAULT_LABEL](#)
The `SA_USER_ADMIN.SET_DEFAULT_LABEL` procedure sets the user's initial session label to the one specified.
- [SA_USER_ADMIN.SET_ROW_LABEL](#)
The `SA_USER_ADMIN.SET_ROW_LABEL` procedure sets a user's initial row label to the one specified.
- [Dominance Rules for Labels with Inverse Groups](#)
You should understand how dominance rules work for Oracle labels and inverse groups.

14.7.2 Setting Current Session or Row Labels for Standard or Inverse Groups

You can set the current session or row labels for standard or inverse groups.

- [About Setting Current Session or Row Labels for Standard or Inverse Groups](#)
The use of inverse groups affects the behavior of the `SA_SESSION.SET_LABEL` and `SA_SESSION.SET_ROW_LABEL` procedures.
- [Standard Groups: Rules for Changing Current Session/Row Labels](#)
With standard groups, the `SA_SESSION.SET_LABEL` procedure can set the session label to include groups in the user's authorized group list.
- [Inverse Groups: Rules for Changing Current Session/Row Labels](#)
With inverse groups, the addition of groups to the session label *decreases* a user's ability to access sensitive data with fewer groups.

14.7.2.1 About Setting Current Session or Row Labels for Standard or Inverse Groups

The use of inverse groups affects the behavior of the `SA_SESSION.SET_LABEL` and `SA_SESSION.SET_ROW_LABEL` procedures.

These procedures can be used to set the user's current session label and row label, respectively.

14.7.2.2 Standard Groups: Rules for Changing Current Session/Row Labels

With standard groups, the `SA_SESSION.SET_LABEL` procedure can set the session label to include groups in the user's authorized group list.

Subgroups of authorized groups are implicitly included in the authorized list.

Note that if you change the session label, then this may affect the value of the session's row label.

Use the `SET_ROW_LABEL` procedure to set the row label value for the current database session. The compartments and groups in the label must be a subset of compartments and groups in the session label to which the user has write access.

14.7.2.3 Inverse Groups: Rules for Changing Current Session/Row Labels

With inverse groups, the addition of groups to the session label *decreases* a user's ability to access sensitive data with fewer groups.

The removal of groups enables the user to access *more* sensitive information. So, the user should be allowed to add groups to the session label, as long as Max Read Groups is a subset of the groups in the session label, and Max Write Groups is a superset of groups in the session label. The same restriction applies when a user removes groups from the session label.

Note that there are no subgroups of authorized groups when using inverse groups. This is because parent groups are not allowed in policies using inverse groups.

Use the `SET_ROW_LABEL` procedure to set the row label value for the current database session. The compartments in the label must be a subset of compartments in the session label to which the user has write access.

The user is allowed to add inverse groups to the row label, as long as the session label inverse groups are a subset of the row label inverse groups, and Max Write Groups is a superset of inverse groups in the row label.

For example:

- If the user has the inverse groups UK and US as their Max Read Groups, and UK,US,CAN as their Max Write Groups. The user can set their session label to `C:ALPHA:UK,US,CAN` but not to `C:ALPHA:UK`.
- If the user has the inverse group UK as their Max Read Groups, and UK,CAN as their Max Write Groups assigned to him. The user can set the session label to `C:ALPHA:UK,CAN` but cannot change it to either `C:ALPHA` or `C:ALPHA:UK,US,CAN`.

Related Topics

- [SA_SESSION.SET_LABEL](#)
The `SA_SESSION.SET_LABEL` procedure sets the label of the current database session.
- [SA_SESSION.SET_ROW_LABEL](#)
The `SA_SESSION.SET_ROW_LABEL` procedure sets the default row label value for the current database session.

14.7.3 Examples of Session Labels and Inverse Groups

Oracle provides examples of using inverse groups.

- [Example: Simple Inverse Groups](#)
You can create a simple policy that implements inverse groups with a set of special labels.
- [Example: Complex Inverse Groups](#)
You can create a more complex policy that implements inverse groups with a set of special labels.

14.7.3.1 Example: Simple Inverse Groups

You can create a simple policy that implements inverse groups with a set of special labels.

Table 14-6 Labels for Inverse Groups Example 1

Name	Definition
Max Read Label	SE:ALPHA,BETA:G1,G2
Max Write Label	SE:ALPHA:G1,G2,G3
Default Read Label	SE:ALPHA,BETA:G1,G2
Default Write Label	SE:ALPHA:G1,G2

Table 14-6 (Cont.) Labels for Inverse Groups Example 1

Name	Definition
Default Row Label	SE:ALPHA:G1,G2
From which the following values are derived:	-
Max Read Groups	G1,G2
Max Write Groups	G1,G2,G3

The following conclusions can be drawn:

- User01 can update data with label SE:ALPHA:G1,G2 as well as data with label SE:ALPHA:G1,G2,G3. User1 *cannot*, however, update label SE:ALPHA:G1.
If standard groups were being used, rather than inverse groups, then User1 could update data with label SE:ALPHA:G1.
- Data that User01 inserts has the label SE:ALPHA:G1,G2. (This is the same as with standard groups.)
- If User01 leaves the default label as is, and sets the row label to SE:ALPHA:G1,G2,G3, then user1 will insert SE:ALPHA:G1,G2,G3 in new rows of data that is written. (In standard groups, User1 can never set more groups in the row label than in the default label.)

14.7.3.2 Example: Complex Inverse Groups

You can create a more complex policy that implements inverse groups with a set of special labels.

Table 14-7 Labels for Inverse Groups Example 2

Name	Definition
Max Read Label	C:ALPHA:
Max Write Label	C:ALPHA:G1,G2,G3
Default Read Label	C:ALPHA:
Default Write Label	C:ALPHA:
Default Row Label	C:ALPHA:
From which the following values are derived:	-
Max Read Groups	(an empty set)
Max Write Groups	G1,G2,G3

The following conclusions can be drawn:

- User01 can update any data with level C, compartment ALPHA, and any combination of groups G1, G2, G3, or no groups. User01 inserts the label C:ALPHA: in new data that User01 writes.
- User02, who has Max Read Groups of G1,G2 or G1,G3, and so on, will not be able to view the data written by User01. This is because User01's Default Row Label contains no groups.

- `User01` can choose to set inverse groups in the row label, as long as the inverse groups in the session label dominates the row label (that is, `User01`'s session label contains the same or fewer groups than contained in the row label).
This is true because the row label must have at least the groups in the session label, and can at most have the Maximum Write Groups. If the session label is `G1`, then you can set the groups in the row label from `G1` to the Max Write Groups (`G1,G2,G3`).
- If `User01` sets their session label and row label to `C:ALPHA:G1:G2:G3`, then their data becomes accessible to anyone who has any combination of `G1,G2,G3` in their Max Read Groups.

14.8 Changes in Behavior of Procedures with Inverse Groups

The `INVERSE_GROUP` option affects algorithms that determine the read and write access of the user to labeled data.

- [SA_SYSDBA.CREATE_POLICY with Inverse Groups](#)
The `SA_SYSDBA.CREATE_POLICY` procedure creates the policy, defines an optional policy-specific column name, and specifies policy options.
- [SA_SYSDBA.ALTER_POLICY with Inverse Groups](#)
The `SA_SYSDBA.ALTER_POLICY` procedure changes a policy's default enforcement options, except for the `INVERSE_GROUP` option.
- [SA_USER_ADMIN.ADD_GROUPS with Inverse Groups](#)
The `SA_USER_ADMIN.ADD_GROUPS` procedure adds groups to a user, indicating whether the groups are authorized for write as well as read.
- [SA_USER_ADMIN.ALTER_GROUPS with Inverse Groups](#)
The `SA_USER_ADMIN.ALTER_GROUPS` procedure changes the write access, default label indicator, and row label indicator for each group.
- [SA_USER_ADMIN.SET_GROUPS with Inverse Groups](#)
The `SA_USER_ADMIN.SET_GROUPS` procedure assigns groups to a user and identifies default values for the user's session label and row label.
- [SA_USER_ADMIN.SET_USER_LABELS with Inverse Groups](#)
The `SA_USER_ADMIN.SET_USER_LABELS` procedure sets the user's levels, compartments, and groups using a set of labels, instead of the individual components.
- [SA_USER_ADMIN.SET_DEFAULT_LABEL with Inverse Groups](#)
The `SA_USER_ADMIN.SET_DEFAULT_LABEL` procedure sets the user's initial session label.
- [SA_USER_ADMIN.SET_ROW_LABEL with Inverse Groups](#)
The `SA_USER_ADMIN.SET_ROW_LABEL` procedure sets the user's initial row label.
- [SA_COMPONENTS.CREATE_GROUP with Inverse Groups](#)
The `SA_COMPONENTS.CREATE_GROUP` procedure create a group, including its short name and long name, and optionally a parent group.
- [SA_COMPONENTS.ALTER_GROUP_PARENT with Inverse Groups](#)
The `SA_COMPONENTS.ALTER_GROUP_PARENT` function is disabled for policies with the inverse group option.
- [SA_SESSION.SET_LABEL with Inverse Groups](#)
The `SA_SESSION.SET_LABEL` procedure sets the label of the current database session.
- [SA_SESSION.SET_ROW_LABEL with Inverse Groups](#)
The `SET_ROW_LABEL` procedure sets the default row label value for the current database session.

- [OLS_LEAST_UBOUND with Inverse Groups](#)
The `OLS_LEAST_UBOUND` (`OLS_LUBD`) function returns a character string label that is the least upper bound of `label1` and `label2`.
- [OLS_GREATEST_LBOUND with Inverse Groups](#)
The `OLS_GREATEST_LBOUND` function determines the lowest label of the data that can be involved in an operation, given two different labels.

14.8.1 SA_SYSDBA.CREATE_POLICY with Inverse Groups

The `SA_SYSDBA.CREATE_POLICY` procedure creates the policy, defines an optional policy-specific column name, and specifies policy options.

With inverse group support the, user has one more policy enforcement option, `INVERSE_GROUP`. For example:

```
PROCEDURE CREATE_POLICY (
  HR IN VARCHAR2,
  SA_LABEL IN VARCHAR2 DEFAULT NULL,
  INVERSE_GROUP IN VARCHAR2 DEFAULT NULL);
```

Related Topics

- [SA_SYSDBA.CREATE_POLICY](#)
The `SA_SYSDBA.CREATE_POLICY` procedure creates a new Oracle Label Security policy, defines a policy-specific column name, and specifies default policy options.

14.8.2 SA_SYSDBA.ALTER_POLICY with Inverse Groups

The `SA_SYSDBA.ALTER_POLICY` procedure changes a policy's default enforcement options, except for the `INVERSE_GROUP` option.

Once a policy is configured for inverse groups, it cannot be changed. You can also change the column names associated with an OLS policy.

Related Topics

- [SA_SYSDBA.ALTER_POLICY](#)
The `SA_SYSDBA.ALTER_POLICY` procedure sets and modifies column names that are associated with the policy.

14.8.3 SA_USER_ADMIN.ADD_GROUPS with Inverse Groups

The `SA_USER_ADMIN.ADD_GROUPS` procedure adds groups to a user, indicating whether the groups are authorized for write as well as read.

The type of access authorized depends on the `access_mode` parameter.

Table 14-8 Access Authorized by Values of `access_mode` Parameter

Access_Mode Parameter	Meaning
<code>READ_WRITE</code>	Indicates that write is authorized. (That is, the group is contained in both Max Read Groups and Max Write Groups.)
<code>WRITE_ONLY</code>	Indicates that the group is contained in Max Write Groups and not in Max Read Groups

Table 14-8 (Cont.) Access Authorized by Values of access_mode Parameter

Access_Mode Parameter	Meaning
access_mode	<p>If access_mode is set to READ_WRITE, then the group is added to both Max Read Groups and Max Write Groups.</p> <p>If access_mode is set to SA_UTL.WRITE_ONLY, then the group is added only to the Max Write Groups.</p> <p>If access_mode is NULL, then it is set to SA_UTL.READ_WRITE.</p>
in_def	<p>Specifies whether these groups should be in the default groups (Y/N).</p> <p>If in_def is NULL, then it will be set to Y or N as follows:</p> <p>If access mode is READ_WRITE, in_def is set to Y.</p> <p>If access mode is WRITE_ONLY, in_def is set to N.</p>
in_row	<p>Specifies whether these groups should be in the row label (Y/N), using the identical criteria as for in_def.</p> <p>However, if in_def is Y, then in_row must also be Y.</p>

Note that if in_def is Y in a row, then in_row must also be set to Y, but not the other way round.

The same is the case with the in_row field.



See Also:

- Syntax for [SA_USER_ADMIN.ADD_GROUPS](#)
- [Inverse Groups and Computed Max Read Groups and Max Write Groups](#)

14.8.4 SA_USER_ADMIN.ALTER_GROUPS with Inverse Groups

The SA_USER_ADMIN.ALTER_GROUPS procedure changes the write access, default label indicator, and row label indicator for each group.

The behavior of inverse groups is the same as described in the case of ADD_GROUPS.



See Also:

- Syntax for [SA_USER_ADMIN.ALTER_GROUPS](#)

14.8.5 SA_USER_ADMIN.SET_GROUPS with Inverse Groups

The SA_USER_ADMIN.SET_GROUPS procedure assigns groups to a user and identifies default values for the user's session label and row label.

Inverse groups are handled differently than standard groups, as follows:

Table 14-9 Assigning Groups to a User

Group Set Name	Meaning
read_groups	A comma-delimited list of groups that would be Max Read Groups
write_groups	A comma-delimited list of groups that would be Max Write Groups. It must be a superset of read_groups. If write_groups is NULL, then they are set to read_groups.
def_groups	Specifies the default groups. It should at least have read_groups, and write_groups should be a superset of def_groups. If def_groups is NULL, then they are set to the read_groups.
row_groups	Specifies the row groups. It should at least have the def_groups and should be a subset of max write groups. If row_groups is NULL, then they are set to the def_groups, because for inverse groups, all def_groups are also in write_groups.



See Also:

Syntax for [SA_USER_ADMIN.SET_GROUPS](#)

14.8.6 SA_USER_ADMIN.SET_USER_LABELS with Inverse Groups

The `SA_USER_ADMIN.SET_USER_LABELS` procedure sets the user's levels, compartments, and groups using a set of labels, instead of the individual components.

Inverse groups are handled differently than standard groups, as follows:

Table 14-10 Inverse Group Label Definitions

Name	Definition
max_read_label	Specifies the label string to be used to initialize the user's maximum authorized read label. Composed of the user's maximum level, compartments authorized for read access, and if inverse groups, minimum set of groups that can be set in any label.(Max Read Groups)
max_write_label	Specifies the label string to be used to initialize the user's maximum authorized write label. Composed of the user's maximum level, compartments authorized for write access, and if inverse groups, the maximum authorized groups that can be set in any label (Max Write Groups). All the inverse groups in this have write authorization also. It should be a superset of groups in max_read_label. If max_write_label is not specified, then it is set to max_read_label.
def_label	Specifies the label string to be used to initialize the user's session label, including level, compartments, and groups (a subset of max_read_label). If default_label is not specified, then it is set to max_read_label. For inverse groups, component it should at least have the groups in max_read_label, and groups in max_write_label should be a superset of the groups in the def_label.

Table 14-10 (Cont.) Inverse Group Label Definitions

Name	Definition
row_label	Specifies the label string to be used to initialize the program's row label. Includes levels, compartments, and groups: subsets of max_write_label and def_label. If row_label is not specified, then it is set to def_label, with only the compartments and groups authorized for write access. The inverse groups component is set to the same as that in def_label if the row_label is not specified. The inverse groups in row label should at least be those in default label and should be a subset of Max Write Groups.

**See Also:**Syntax for [SA_USER_ADMIN.SET_USER_LABELS](#)

14.8.7 SA_USER_ADMIN.SET_DEFAULT_LABEL with Inverse Groups

The `SA_USER_ADMIN.SET_DEFAULT_LABEL` procedure sets the user's initial session label.

All the rules mentioned for setting inverse groups component of session label mentioned in [Session Labels and Inverse Groups](#) are applicable here.

**See Also:**Syntax for [SA_USER_ADMIN.SET_DEFAULT_LABEL](#)

14.8.8 SA_USER_ADMIN.SET_ROW_LABEL with Inverse Groups

The `SA_USER_ADMIN.SET_ROW_LABEL` procedure sets the user's initial row label.

When specifying the `row_label`, the inverse groups component must contain at least all the inverse groups in `def_label` and should be a subset of Max Write Groups.

**See Also:**

- Syntax for [SA_USER_ADMIN.SET_ROW_LABEL](#)
- [Initial Session and Row Labels for Standard or Inverse Groups](#)

14.8.9 SA_COMPONENTS.CREATE_GROUP with Inverse Groups

The `SA_COMPONENTS.CREATE_GROUP` procedure create a group, including its short name and long name, and optionally a parent group.

With inverse groups, the `parent_name` field should always be `NULL`. If the user specifies a value for this field, then an error message is displayed, indicating that the group hierarchy is disabled.



See Also:

Syntax for [SA_COMPONENTS.CREATE_GROUP](#)

14.8.10 SA_COMPONENTS.ALTER_GROUP_PARENT with Inverse Groups

The `SA_COMPONENTS.ALTER_GROUP_PARENT` function is disabled for policies with the inverse group option.

An error message is displayed if the user calls this function.



See Also:

Syntax for [SA_COMPONENTS.ALTER_GROUP](#)

14.8.11 SA_SESSION.SET_LABEL with Inverse Groups

The `SA_SESSION.SET_LABEL` procedure sets the label of the current database session.

For the current user, this procedure follows the same rules for setting the session label as does the `SA_USER_ADMIN.SET_USER_LABEL` function.



See Also:

- Syntax for [SA_SESSION.SET_LABEL](#).
- [Setting Current Session or Row Labels for Standard or Inverse Groups](#)

14.8.12 SA_SESSION.SET_ROW_LABEL with Inverse Groups

The `SET_ROW_LABEL` procedure sets the default row label value for the current database session.

For the current user, this procedure follows the same rules for setting the row label as does the `sa_user_admin.set_row_label` function.

 **See Also:**

- Syntax for [SA_SESSION.SET_ROW_LABEL](#)
- [Initial Session and Row Labels for Standard or Inverse Groups](#)

14.8.13 OLS_LEAST_UBOUND with Inverse Groups

The `OLS_LEAST_UBOUND (OLS_LUBD)` function returns a character string label that is the least upper bound of `label1` and `label2`.

With *standard* groups, the least upper bound is the highest level, the union of the compartments in the labels, and *the union of the groups* in the labels.

With *inverse* groups, the least upper bound is the highest level, the union of the compartments in the labels, and *the intersection of the inverse groups* in the labels.

For example, with inverse groups, the least upper bound of `HIGHLY_SENSITIVE:ALPHA:G1,G2` and `SENSITIVE:BETA:G1` is `HIGHLY_SENSITIVE:ALPHA,BETA:G1`.

14.8.14 OLS_GREATEST_LBOUND with Inverse Groups

The `OLS_GREATEST_LBOUND` function determines the lowest label of the data that can be involved in an operation, given two different labels.

This function returns a character string label that is the greatest lower bound of `label1` and `label2`.

With *standard* groups, the greatest lower bound is the lowest level, and *the intersection of the compartments in the labels and the groups* in the labels.

With *inverse* groups, the greatest lower bound is the lowest level, and *the intersection of the compartments in the labels and the union of inverse groups* in the labels.

For example, with inverse groups the greatest lower bound of `HIGHLY_SENSITIVE:ALPHA:G1,G3` and `SENSITIVE::G1` is `SENSITIVE:G1,G3`

Related Topics

- [Determination of the Upper and Lower Bounds of Labels](#)
Oracle Label Security provides functions that determine the least upper bound or the greatest lower bound of two or more labels.

14.9 Dominance Rules for Labels with Inverse Groups

You should understand how dominance rules work for Oracle labels and inverse groups.

Dominance rules for Oracle Label Security with standard groups can be summarized as follows:

A user label dominates a data label if:

- User level is greater than or equal to the data level
- User compartments are a superset of the data compartments

- User groups intersects (have at least one group from) the data groups

Dominance rules for Oracle Label Security with inverse groups can be summarized as follows:

A user label dominates a data label if:

- User level is greater than or equal to the data level
- User compartments are a superset of the data compartments
- Data groups are a superset of user groups

Related Topics

- [About Dominant and Dominated Labels](#)
The relationship between two labels can be described in terms of *dominance*.

Auditing Oracle Label Security

All activities in Oracle Label Security can be audited, including Oracle Label Security administrator activities.

- [Auditing Oracle Label Security Using Unified Auditing](#)
Oracle recommends that you migrate all your Oracle Label Security audit policies to unified auditing.
- [Auditing Oracle Label Security Using Traditional Auditing](#)
Traditional auditing is desupported, but traditional audit settings in an upgraded database can be used with some limitations.
- [Disabling Traditional Auditing for Oracle Label Security Policies](#)
Oracle recommends that you disable traditional auditing for Oracle Label Security policies and use unified auditing instead.

15.1 Auditing Oracle Label Security Using Unified Auditing

Oracle recommends that you migrate all your Oracle Label Security audit policies to unified auditing.

To create **new** audit policies in Oracle Label Security, you must use unified auditing. Traditional auditing is no longer supported as of Oracle Database 23ai for new audit settings, though the current existing traditional audit settings are still honored.

The unified audit trail will capture Oracle Label Security unified audit policy records, as well as mandatory Oracle Label Security audits.

Unified auditing enables you to create custom policies that capture more fine-tuned data than you can capture with traditional Oracle Label Security auditing. For example, you can create unified auditing policies that capture Oracle Label Security-specific events such as the creation, modification, and removal of Oracle Label Security policies, as well as activities such as authorization and actions that require Oracle Label Security privileges. The policies can incorporate standard unified audit features, such as conditions, application context values, and the ability to audit top-level statements.

In addition to this functionality, unified auditing provides the following predefined audit policies:

- `ORA_DV_SCHEMA_CHANGES`, which monitors Oracle Label Security `LBACSYS` and Oracle Database Vault `DVSY` schema objects when Oracle Database Vault is in use.
- `ORA_OLS_SCHEMA_CHANGES`, which also monitors `LBACSYS` schema objects. You can use this audit policy can if Oracle Database Vault is not in use. You do not need to enable this policy if `ORA_DV_SCHEMA_CHANGES` is already enabled.

In a new Oracle Database installation, `ORA_DV_SCHEMA_CHANGES` is enabled by default. In an upgraded Oracle database, it is not enabled by default. Uninstallation of Oracle Database Vault drops `ORA_DV_SCHEMA_CHANGES`. To ensure that `LBACSYS` objects are still audited, `ORA_OLS_SCHEMA_CHANGES` will be enabled during uninstallation of Oracle Database Vault, if `ORA_DV_SCHEMA_CHANGES` was enabled.

When you create a new policy, a label column for that policy is added to the database audit trail. The label column is created regardless of whether auditing is enabled or disabled, and

independent of whether database auditing or operating system auditing is used. Whenever a record is written to the audit table, each policy provides a label for that record to indicate the session label. The administrator can create audit views to display these labels. Note that in the audit table, the label does not control access to the row, instead it only records the sensitivity of the row.

When you use unified auditing, the Oracle Label Security traditional audit settings will continue to collect audit records, until you do the following: complete migrating the audit settings to unified auditing, disable traditional auditing, and then archive and purge the older audit records. From then on, you can manage Oracle Label Security audit policies through the unified audit policy PL/SQL statements.

All configuration changes made to Oracle Label Security are mandatorily audited and these audit records are written to the unified audit trail, including actions of unprivileged users who attempt to modify Oracle Label Security policies.

Consider auditing any operations that require Oracle Label Security privileges. Because these privileges perform sensitive operations, and because their abuse could jeopardize security, you should closely monitor their dissemination and use.

To learn how to create unified audit policies for Oracle Label Security, see *Oracle Database Security Guide*. See also *Oracle Database Security Guide* for more information about how the desupport of traditional auditing works.

15.2 Auditing Oracle Label Security Using Traditional Auditing

Traditional auditing is desupported, but traditional audit settings in an upgraded database can be used with some limitations.

Though traditional auditing is desupported starting in Oracle Database release 23ai, any current existing Oracle Label Security traditional audit settings that you have will be maintained when you upgrade to release 23ai and the Oracle Label Security data dictionary views will continue to capture this audit information. You can delete existing traditional audit settings. However, you cannot create new traditional audit settings. Instead, you must create unified audit policies to replace the traditional audit policies that you need to update.

The traditional audit settings are controlled through the `SA_AUDIT_ADMIN` PL/SQL package. The audit indicates if the user's action succeeded (that is, the policy enabled the user to accomplish a task) or if the user's action failed (the policy was violated). Oracle Label Security uses this package to collect audit records and write these audit records to the Oracle Label Security data dictionary views.

When you install a new database and configure it to use Oracle Label Security, then it uses unified auditing only. If you have upgraded from a previous release, then Oracle Label Security uses the auditing that was implemented in that release.

The traditional audit trail lists only the action numbers. To find the corresponding audit action names, you can query the `LABACSYS.OLS$AUDIT_ACTIONS` system table. You must have the `AUDIT_VIEWER`, `AUDIT_ADMIN`, or `policy_DBA` role to query this table.

See *Oracle Database Security Guide* for more information about how the desupport of traditional auditing works.

15.3 Disabling Traditional Auditing for Oracle Label Security Policies

Oracle recommends that you disable traditional auditing for Oracle Label Security policies and use unified auditing instead.

1. Log in to the database instance as a user who has the `LBAC_DBA` database role (or the `policy_DBA` role for a specific policy).
2. If necessary, query the `ALL_SA_POLICIES` data dictionary view to find the policies whose traditional auditing you want to disable.
3. Run the `SA_AUDIT_ADMIN.NOAUDIT` procedure to disable auditing for the policy.

For example:

```
BEGIN
  SA_AUDIT_ADMIN.NOAUDIT (
    policy_name      => 'hr_ols_pol',
    users            => 'jjones',
    audit_option     => NULL);
END;
/
```

In this specification,

- `policy_name`: The policy name is required. To find existing policies, query the `POLICY_NAME` column of the `ALL_SA_POLICIES` data dictionary view.
- `users`: This setting is a comma-delimited list of users who were audited. If you omit this setting or specify `NULL` for the `users` parameter, then auditing is disabled for all users. To find users who have privileges to modify Oracle Label Security policies, query the `USER_NAME` column of the `ALL_SA_AUDIT_OPTIONS` view.
- `audit_option`: `NULL` is specified to disable all audit options that have been applied to the `hr_ols_pol` policy. If you want to disable only specific options, then the choices are as follows:
 - `APPLY`: Disables auditing of the application of specified Oracle Label Security policies to tables and schemas
 - `REMOVE`: Disables auditing of the removal of specified Oracle Label Security policies from tables and schemas
 - `SET`: Disables auditing of the setting of user authorizations, and user and program privileges
 - `PRIVILEGES`: Disables auditing of the use of all policy-specific privileges

Related Topics

- [SA_AUDIT_ADMIN.NOAUDIT](#)
The `SA_AUDIT_ADMIN.NOAUDIT` procedure disables Oracle Label Security policy-specific auditing.
- [ALL_SA_POLICIES](#)
The `ALL_SA_POLICIES` data dictionary view shows for the current user information about Oracle Label Security policies, based on the `SA_SYSDBA.CREATE_POLICY` procedure.

Part V

Appendixes

Part IV contains reference material for using Oracle Label Security.

- [Disabling, Enabling, Uninstalling, and Reinstalling Oracle Label Security](#)
You can disable, enable, uninstall, and reinstall Oracle Label Security from the command line.
- [Advanced Topics in Oracle Label Security](#)
Oracle provides advanced functionality for Oracle Label Security, such as the ability to analyze relationships between labels.
- [Oracle Label Security in an Oracle RAC Environment](#)
You can use Oracle Label Security in an Oracle Real Application Clusters (Oracle RAC) environment.
- [Oracle Label Security PL/SQL Packages](#)
Oracle Label Security provides a set of PL/SQL packages.
- [Oracle Label Security Tables and Views](#)
Oracle Label Security provides data dictionary tables, data dictionary views, and an user-created auditing view.
- [Oracle Label Security Restrictions](#)
Several restrictions exist in this Oracle Label Security release.
- [Frequently Asked Questions about Oracle Label Security](#)
Customers have frequently asked questions about Oracle Label Security.
- [Troubleshooting Oracle Label Security](#)
Oracle provides guidance for troubleshooting Oracle Label Security tasks.

A

Disabling, Enabling, Uninstalling, and Reinstalling Oracle Label Security

You can disable, enable, uninstall, and reinstall Oracle Label Security from the command line.

- [Disabling and Enabling Oracle Label Security](#)
You can disable and enable Oracle Label Security as necessary.
- [Uninstalling and Reinstalling Oracle Label Security](#)
You can uninstall and reinstall Oracle Label Security as necessary.

A.1 Disabling and Enabling Oracle Label Security

You can disable and enable Oracle Label Security as necessary.

- [When You Must Disable Oracle Label Security](#)
You may need to disable Oracle Label Security to perform upgrade tasks or correct erroneous configurations.
- [Disabling Oracle Label Security](#)
If Oracle Database Vault has been enabled, then do not disable Oracle Label Security.
- [Enabling Oracle Label Security](#)
You can enable Oracle Label Security in SQL*Plus.

A.1.1 When You Must Disable Oracle Label Security

You may need to disable Oracle Label Security to perform upgrade tasks or correct erroneous configurations.

Another reason for disabling Oracle Label Security is if you want to test an application without enforcing Oracle Label Security. You can reenable Oracle Label Security after you complete the tasks.

You must also disable Oracle Label Security before you uninstall it.

Related Topics

- [Checking if Oracle Label Security Has Been Registered and Enabled](#)
You can query the `DBA_OLS_STATUS` data dictionary view to find if Oracle Label Security has already been registered and enabled.

A.1.2 Disabling Oracle Label Security

If Oracle Database Vault has been enabled, then do not disable Oracle Label Security.

1. Log into the PDB the Oracle Label Security administrator.
To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.
2. Query the `DBA_DV_STATUS` data dictionary view to find if Oracle Database Vault has been enabled in this PDB.

Oracle Database Vault depends on Oracle Label Security. If Oracle Database Vault is installed in the PDB, then do not disable Oracle Label Security.

```
SELECT * FROM DBA_DV_STATUS;
```

Output similar to the following should appear:

NAME	STATUS
-----	-----
DV_CONFIGURE_STATUS	FALSE
DV_ENABLE_STATUS	FALSE

If the output is FALSE, then you can disable Oracle Label Security.

3. Run the following procedure:

```
EXEC LBACSYS.OLS_ENFORCEMENT.DISABLE_OLS;
```

4. Connect to the CDB as a user with the SYSDBA administrative privilege.

```
CONNECT / AS SYSDBA
```

5. Close and reopen the PDB.

For example:

```
ALTER PLUGGABLE DATABASE pdb_name CLOSE IMMEDIATE;  
ALTER PLUGGABLE DATABASE pdb_name OPEN;
```

6. For Oracle Real Application Clusters (Oracle RAC), repeat these steps for each Oracle RAC node on which you enabled Oracle Label Security.

A.1.3 Enabling Oracle Label Security

You can enable Oracle Label Security in SQL*Plus.

1. Log into the PDB the Oracle Label Security administrator.

To find the available PDBs, query the DBA_PDBS data dictionary view. To check the current PDB, run the `show con_name` command.

2. Run the following procedure:

```
EXEC LBACSYS.OLS_ENFORCEMENT.ENABLE_OLS;
```

3. Connect to the CDB as a user with the SYSDBA administrative privilege.

```
CONNECT / AS SYSDBA
```

4. Close and reopen the PDB.

For example:

```
ALTER PLUGGABLE DATABASE pdb_name CLOSE IMMEDIATE;  
ALTER PLUGGABLE DATABASE pdb_name OPEN;
```

5. For Oracle Real Application Clusters (Oracle RAC), repeat these steps for each Oracle RAC node on which you enabled Oracle Label Security.

A.2 Uninstalling and Reinstalling Oracle Label Security

You can uninstall and reinstall Oracle Label Security as necessary.

- [Uninstalling Oracle Label Security](#)
You can use the `catnools.sql` script to uninstall Oracle Label Security from a pluggable database (PDB).
- [Reinstalling Oracle Label Security](#)
You can reinstall Oracle Label Security in a PDB but not in the CDB root.

A.2.1 Uninstalling Oracle Label Security

You can use the `catnools.sql` script to uninstall Oracle Label Security from a pluggable database (PDB).

You can only uninstall Oracle Label Security from a PDB, not from the CDB root or the application container root.

1. Log into the PDB as the Oracle Label Security administrator.

To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.

2. Ensure that Oracle Database Vault is not installed on this PDB by querying the `DBA_USERS` data dictionary view for the user `DVSYs`.

```
SELECT USERNAME FROM DBA_USERS WHERE USERNAME = 'DVSYs';
```

If the output shows `DVSYs`, then Oracle Database Vault is installed and you will need to uninstall Oracle Database Vault before you uninstall Oracle Label Security from the PDB.

3. Disable Oracle Label Security.

You can find if Oracle Label Security has been enabled by querying the `DBA_OLS_STATUS` data dictionary view.

4. Enter the following command to uninstall Oracle Label Security:

```
@?/rdbms/admin/catnools.sql value [value]
```

In this specification, `value` refers to one of the following settings:

- `LBACSYS` uninstalls the `LBACSYS` schema only. You must be user `SYS` with the `SYSDBA` administrative privilege to use this option. For example:

```
@?/rdbms/admin/catnools.sql LBACSYS
```

- `POLICIES` uninstalls policies but retains the OLS label column. You must have the `LBAC_DBA` role (or be user `LBACSYS`) to use this option.

```
@?/rdbms/admin/catnools.sql POLICIES
```

- `POLICIES_WITH_DATA` uninstalls OLS policies without retaining the OLS label column. You must have the `LBAC_DBA` role (or be user `LBACSYS`) to use this option.

```
@?/rdbms/admin/catnools.sql POLICIES_WITH_DATA
```

5. Connect to the CDB as a user with the `SYSDBA` administrative privilege.

```
CONNECT / AS SYSDBA
```

6. Close and reopen the PDB.

For example:

```
ALTER PLUGGABLE DATABASE pdb_name CLOSE IMMEDIATE;
ALTER PLUGGABLE DATABASE pdb_name OPEN;
```

7. For Oracle Real Application Clusters (Oracle RAC), repeat these steps for each Oracle RAC node on which you enabled Oracle Label Security.

Related Topics

- [Checking if Oracle Label Security Has Been Registered and Enabled](#)
You can query the `DBA_OLS_STATUS` data dictionary view to find if Oracle Label Security has already been registered and enabled.
- [Disabling Oracle Label Security](#)
If Oracle Database Vault has been enabled, then do not disable Oracle Label Security.
- *Oracle Database Vault Administrator's Guide*

A.2.2 Reinstalling Oracle Label Security

You can reinstall Oracle Label Security in a PDB but not in the CDB root.

1. Log into the PDB as the Oracle Label Security administrator.

To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.

2. Query the `DBA_OLS_STATUS` data dictionary view to find if Oracle Label Security has already been installed and enabled in this PDB.

For example:

```
SELECT NAME, STATUS FROM DBA_OLS_STATUS;
```

If the `DBA_OLS_STATUS` data dictionary view is not recognized, then Oracle Label security is not installed and you can reinstall it. If the output is as follows, showing `FALSE`, then you only need to register Oracle Label Security.

NAME	STATUS
OLS_CONFIGURE_STATUS	FALSE
OLS_ENABLE_STATUS	FALSE

3. Exit SQL*Plus.
4. Enter the following command to reinstall Oracle Label Security:

```
@?/rdbms/admin/catols.sql
```

5. Connect to the CDB as a user with the `SYSDBA` administrative privilege.

```
CONNECT / AS SYSDBA
```

6. Close and reopen the PDB.

For example:

```
ALTER PLUGGABLE DATABASE pdb_name CLOSE IMMEDIATE;
ALTER PLUGGABLE DATABASE pdb_name OPEN;
```


7. Register Oracle Label Security for the PDB.
8. For Oracle Real Application Clusters (Oracle RAC), repeat these steps for each Oracle RAC node on which you enabled Oracle Label Security.

Related Topics

- [Registering and Logging in to Oracle Label Security](#)
Before using Oracle Label Security, you must register (configure) it with the database and then you can log in to Oracle Label Security.

B

Advanced Topics in Oracle Label Security

Oracle provides advanced functionality for Oracle Label Security, such as the ability to analyze relationships between labels.

- [Analyzing the Relationships Between Labels](#)
You can analyze the relationships between labels.
- [Queries for Audited Oracle Label Security Session Labels](#)
You can use the unified audit trail to capture information from various audit sources, including Oracle Label Security.
- [Oracle Call Interface for Setting Session Labels](#)
You can use an Oracle Call Interface (OCI) to set session labels.

B.1 Analyzing the Relationships Between Labels

You can analyze the relationships between labels.

- [About Dominant and Dominated Labels](#)
The relationship between two labels can be described in terms of *dominance*.
- [Non-Comparable Labels](#)
It is important to understand how labels can be compared with regard to dominance.
- [Using Dominance Functions](#)
Oracle Label Security provides functions to control dominance.

B.1.1 About Dominant and Dominated Labels

The relationship between two labels can be described in terms of *dominance*.

A user's ability to access an object depends on whether the user's label dominates the label of the object. If a user's label does not dominate the object's label, then the user is not allowed to access the object.

Label dominance is analyzed in terms of all its components: levels, compartments, and groups.

Table B-1 Dominance in the Comparison of Labels

Factor	Criteria for Dominance
Level	For label1 to dominate label2, the level of label1 must be greater than or equal to that of label2.
Compartment	For label1 to dominate label2, the compartments of label1 must contain <i>all</i> the compartments of label2.
Group	For label1 to dominate label2, label1 must contain <i>at least one</i> of the groups of label2.

One label *dominates* another label if all of its components dominate the components of the other label. For example, the label `HIGHLY_SENSITIVE:FINANCE,OPERATIONS` dominates the label

HIGHLY_SENSITIVE:FINANCE. Similarly, the label HIGHLY_SENSITIVE::WR_AP dominates the label HIGHLY_SENSITIVE::WR_AP, WR_AR.

Related Topics

- [Dominance Rules for Labels with Inverse Groups](#)
You should understand how dominance rules work for Oracle labels and inverse groups.

B.1.2 Non-Comparable Labels

It is important to understand how labels can be compared with regard to dominance.

The relationship between two labels cannot always be defined by dominance. Two labels are *non-comparable* if neither label dominates the other.

If any compartments differ between the two labels (as with HS:A and HS:B), then they are non-comparable. Similarly, the labels HS:A and S:B are non-comparable.

You can find existing labels by querying the DBA_SA_LABELS data dictionary view.

B.1.3 Using Dominance Functions

Oracle Label Security provides functions to control dominance.

- [About the Dominance Functions](#)
You can use dominance functions to specify ranges in queries.
- [OLS_DOMINATES Standalone Function](#)
The OLS_DOMINATES (OLS_DOM) function returns 1 (TRUE) if label1 dominates label2, or 0 (FALSE) if it does not.
- [OLS_LABEL_DOMINATES Standalone Function](#)
The standalone OLS_LABEL_DOMINATES function checks the dominance of session labels.
- [SA_UTL.DOMINATES](#)
The SA_UTL.DOMINATES function returns TRUE if label1 dominates label2 or if the session label for the given OLS policy dominates label.
- [OLS_STRICTLY_DOMINATES Standalone Function](#)
The OLS_STRICTLY_DOMINATES (OLS_S_DOM) function returns 1 (TRUE) if label1 dominates label2 and is not equal to it.
- [OLS_DOMINATED_BY Standalone Function](#)
The OLS_DOMINATED_BY (OLS_DOM_BY) function returns 1 (TRUE) if label1 is dominated by label2.
- [OLS_STRICTLY_DOMINATED_BY Standalone Function](#)
The OLS_STRICTLY_DOMINATED_BY (OLS_S_DOM_BY) function returns 1 (TRUE) if label1 is dominated by label2 and is not equal to it.

Related Topics

- [Ordering Labeled Data Rows](#)
The ORDER BY clause of a SELECT statement can be used to order rows by the numeric label tag.

B.1.3.1 About the Dominance Functions

You can use dominance functions to specify ranges in queries.

The following functions enable you to indicate dominance relationships between specified labels.

Table B-2 Functions to Determine Dominance

Function	Description
OLS_DOMINATES	The value of label1 dominates, or is equal to, that of label2.
OLS_LABEL_DOMINATES	The value of the session label for the corresponding policy_name dominates, or is equal to, that of label.
OLS_STRICTLY_DOMINATES	The value of label1 dominates that of label2, and is not equal to it.
OLS_DOMINATED_BY	The value of label1 is dominated by that of label2.
OLS_STRICTLY_DOMINATED_BY	The value of label1 is dominated by that of label2, and is not equal to it.

Note that there are two types of dominance function. While the SA_UTL dominance functions return BOOLEAN values, the standalone dominance functions return integers.

B.1.3.2 OLS_DOMINATES Standalone Function

The OLS_DOMINATES (OLS_DOM) function returns 1 (TRUE) if label1 dominates label2, or 0 (FALSE) if it does not.

Syntax

```
OLS_DOMINATES (
  label1      IN NUMBER,
  label2      IN NUMBER)
RETURN INTEGER;
```

Parameters

Table B-3 OLS_DOMINATES Parameters

Parameter	Description
label1	The first label to check. To find existing label values, query the LABEL and TAG columns of the ALL_SA_LABELS view.
label2	The second label to check

Example

The following example compares existing label tags 1111 and 1112.

```
SELECT OLS_DOMINATES ('1111', '1112') FROM DUAL;

OLS_DOMINATES('1111','1112')
-----
0
```

B.1.3.3 OLS_LABEL_DOMINATES Standalone Function

The standalone `OLS_LABEL_DOMINATES` function checks the dominance of session labels.

It returns 1 (TRUE) if the session label of the specified `policy_name` value dominates or is equal to the label that is specified by the `label` parameter. Otherwise, this function returns 0 (FALSE). This function is publicly available.

 **Note:**

This feature is available starting with Oracle Database 12c release 1 (12.1.0.2).

In addition to Oracle Label Security policies, you can use this function with both Oracle Data Redaction and Oracle Database Vault policies.

Syntax

```
OLS_LABEL_DOMINATES (
  policy_name  IN VARCHAR2,
  label        IN VARCHAR2)
RETURN INTEGER;
```

Parameters

Table B-4 OLS_LABEL_DOMINATES Parameters

Parameter	Description
<code>policy_name</code>	The name of the Oracle Label Security policy whose session label must be checked for dominance. To find existing label values for policies, query the <code>POLICY_NAME</code> and <code>LABEL</code> columns of the <code>ALL_SA_LABELS</code> view.
<code>label</code>	The base label against whom the dominance has to be checked

Examples

The following example checks if the session label for the `hr_ols_pol` policy dominates or is equal to the `hs` label.

```
SELECT OLS_LABEL_DOMINATES ('hr_ols_pol', 'hs') FROM DUAL;

OLS_LABEL_DOMINATES('HR_OLS_POL','HS')
-----
                                0
```

This example shows how you can use the `OLS_LABEL_DOMINATES` function in an Oracle Data Redaction policy:

```
BEGIN
  DBMS_REDACT.ADD_POLICY(
    object_schema => 'oe',
    object_name   => 'customers',
    column_name   => 'customer_id',
    policy_name   => 'redact_cust_user_ids',
    function_type => DBMS_REDACT.FULL,
```

```

expression      => 'OLS_LABEL_DOMINATES(''hr_ols_pol'', ''hs'') = 0');
END;
/

```

The following example shows how you can use the `OLS_LABEL_DOMINATES` function in an Oracle Database Vault rule definition:

```

EXEC DBMS_MACADM.CREATE_RULE('Check OLS Factor', 'OLS_LABEL_DOMINATES(''hr_ols_pol'',
''hs'') = 1');

```

 **See Also:**

- *Oracle Database Advanced Security Guide* for more information about Data Redaction
- *Oracle Database Vault Administrator's Guide* for more information about Database Vault realms

B.1.3.4 SA_UTL.DOMINATES

The `SA_UTL.DOMINATES` function returns `TRUE` if `label1` dominates `label2` or if the session label for the given OLS policy dominates `label`.

Syntax

```

SA_UTL.DOMINATES (
    label1          IN NUMBER,
    label2          IN NUMBER)
RETURN BOOLEAN;

```

Parameters

Table B-5 SA_UTL.DOMINATES Parameters

Parameter	Description
<code>label1</code>	The first label to check. To find existing label values, query the <code>LABEL</code> and <code>TAG</code> columns of the <code>ALL_SA_LABELS</code> view.
<code>label2</code>	The second label to check

Example

The following example compares existing label tags 1111 and 1112.

```

SET SERVEROUTPUT ON
BEGIN
  IF SA_UTL.DOMINATES(1111, 1112)
    THEN DBMS_OUTPUT.PUT_LINE('Label 1111 dominates label 1112. ');
  ELSE
    DBMS_OUTPUT.PUT_LINE('Label 1112 dominates label 1111. ');
  END IF;
END;
/

```

Label 1112 dominates label 1111.

 **Note:**

You cannot use this function with Oracle Data Redaction and Oracle Database Vault conditions. Oracle recommends that you use the `OLS_LABEL_DOMINATES` function instead.

B.1.3.5 OLS_STRICTLY_DOMINATES Standalone Function

The `OLS_STRICTLY_DOMINATES (OLS_S_DOM)` function returns 1 (TRUE) if `label1` dominates `label2` and is not equal to it.

Syntax

```
OLS_STRICTLY_DOMINATES (
  label1          IN NUMBER,
  label2          IN NUMBER)
RETURN INTEGER;
```

Parameters

Table B-6 OLS_STRICTLY_DOMINATES Parameters

Parameter	Description
<code>label1</code>	The first label to check. To find existing label values, query the <code>LABEL</code> and <code>TAG</code> columns of the <code>ALL_SA_LABELS</code> view.
<code>label2</code>	The second label to check

Examples

The following example compares existing label tags 1111 and 1112.

```
SELECT OLS_STRICTLY_DOMINATES ('1111', '1112') FROM DUAL;

OLS_STRICTLY_DOMINATES('1111','1112')
-----
0
```

B.1.3.6 OLS_DOMINATED_BY Standalone Function

The `OLS_DOMINATED_BY (OLS_DOM_BY)` function returns 1 (TRUE) if `label1` is dominated by `label2`.

Syntax

```
OLS_DOMINATED_BY (
  label1          IN NUMBER,
  label2          IN NUMBER)
RETURN INTEGER;
```

Parameters

Table B-7 OLS_STRICTLY_DOMINATES Parameters

Parameter	Description
label1	The first label to check. To find existing label values, query the LABEL and TAG columns of the ALL_SA_LABELS view.
label2	The second label to check

Example

The following example compares existing label tags 1111 and 1112.

```
SELECT OLS_DOMINATED_BY ('1111', '1112') FROM DUAL;

OLS_DOMINATED_BY('1111','1112')
-----
1
```

B.1.3.7 OLS_STRICTLY_DOMINATED_BY Standalone Function

The OLS_STRICTLY_DOMINATED_BY (OLS_S_DOM_BY) function returns 1 (TRUE) if label1 is dominated by label2 and is not equal to it.

Syntax

```
OLS_STRICTLY_DOMINATED_BY (
  label1          IN NUMBER,
  label2          IN NUMBER)
RETURN INTEGER;
```

Parameters

Table B-8 OLS_DOMINATES Parameters

Parameter	Description
label1	The first label to check. To find existing label values, query the LABEL and TAG columns of the ALL_SA_LABELS view.
label2	The second label to check

Example

The following example compares existing label tags 1111 and 1112.

```
SELECT OLS_STRICTLY_DOMINATES ('1111', '1112') FROM DUAL;

OLS_STRICTLY_DOMINATES('1111','1112')
-----
0
```

B.2 Queries for Audited Oracle Label Security Session Labels

You can use the unified audit trail to capture information from various audit sources, including Oracle Label Security.

- [About Queries for Auditing Oracle Label Security Session Labels](#)
 You must configure Oracle Label Security auditing by creating unified audit policies.
- [ORA_GET_AUDITED_LABEL Function](#)
 The `ORA_GET_AUDITED_LABEL` function returns the audited session label for the specified OLS policy and `APPLICATION_CONTEXTS` column value.

B.2.1 About Queries for Auditing Oracle Label Security Session Labels

You must configure Oracle Label Security auditing by creating unified audit policies.

OLS auditing enables you to audit additional events such as enabling and disabling of OLS policies.

The session labels that the audit trail captures are stored in the `APPLICATION_CONTEXTS` column of the `UNIFIED_AUDIT_TRAIL` view. You can use the `LBACSYS.ORA_GET_AUDITED_LABEL` function to retrieve session labels that are stored in the `APPLICATION_CONTEXTS` column. This function accepts the `UNIFIED_AUDIT_TRAIL.APPLICATION_CONTEXTS` column value, and the Oracle Label Security policy name as arguments, and then returns the session label that is stored in the column for the specified policy.



See Also:

Oracle Database Security Guide for detailed information about configuring and using OLS auditing in a unified audit trail

B.2.2 ORA_GET_AUDITED_LABEL Function

The `ORA_GET_AUDITED_LABEL` function returns the audited session label for the specified OLS policy and `APPLICATION_CONTEXTS` column value.

The `AUDIT_VIEWER` role has `EXECUTE` privilege on the `ORA_GET_AUDITED_LABEL` function.

Syntax

```
ORA_GET_AUDITED_LABEL (
  appctx_col_value  IN VARCHAR2,
  ols_policy_name   IN VARCHAR2)
RETURN VARCHAR2;
```

Parameters

Table B-9 ORA_GET_AUDITED_LABEL Parameters

Parameter	Description
<code>appctx_col_value</code>	Value in the <code>UNIFIED_AUDIT_TRAIL.APPLICATION_CONTEXTS</code> column
<code>policy_name</code>	The label security policy name

Example

The following example returns the audited session label for the `hr_ols_pol` policy.

```
SELECT ORA_GET_AUDITED_LABEL ('cust_ctx', 'hr_ols_pol') FROM DUAL;

ORA_GET_AUDITED_LABEL('X','HR_OLS_POL')
-----
HS
```

B.3 Oracle Call Interface for Setting Session Labels

You can use an Oracle Call Interface (OCI) to set session labels.

- [About Using the Oracle Call Interface to Set Session Labels](#)
When you connect using Oracle Call Interface (OCI), you can use the `SYS_CONTEXT` variables to initialize the session label and the row label.
- [Using the Oracle Call Interface to Set Session Labels](#)
You can use the Oracle Call Interface to set the session labels.
- [Example: Using Oracle Call Interface with the SYS_CONTEXT Function](#)
You can create an OCI call that uses an externalized `SYS_CONTEXT` function with Oracle Label Security.

B.3.1 About Using the Oracle Call Interface to Set Session Labels

When you connect using Oracle Call Interface (OCI), you can use the `SYS_CONTEXT` variables to initialize the session label and the row label.

You can set the variables using the `OCIAttrSet` function to initialize *externally initialized* `SYS_CONTEXT` variables. These are available when Oracle Label Security is enabled.

Each policy has a `SYS_CONTEXT` named `SA$policy_name_X`. You can set these two variables, `INITIAL_LABEL` and `INITIAL_ROW_LABEL`.

When the new values are set to valid labels within the user's authorizations, they will be used instead of the default values stored for the user. This is the same mechanism used for remote connections.

Related Topics

- [Using Oracle Label Security with a Distributed Database](#)
You should understand the special considerations for using Oracle Label Security in a distributed configuration.

B.3.2 Using the Oracle Call Interface to Set Session Labels

You can use the Oracle Call Interface to set the session labels.

1. Call `OCIAttrSet` with `OCI_ATTR_APPCTX_SIZE` to initialize the context array size with the desired number of context attributes:

```
OCIAttrSet(session, OCI_HTYPE_SESSION,
           (dvoid *)&size, (ub4)0, OCI_ATTR_APPCTX_SIZE, error_handle);
```

This defines additional attributes for `OCIAttrSet`.

Note that the size is `ub4` type.

2. Call `OCIAttrGet` with `OCI_ATTR_APPCTX_LIST` to get a handle on the application context list descriptor for the session:

```
OCIAttrGet(session, OCI_HTYPE_SESSION,
           (dvoid *)&ctxl_desc, (ub4)0, OCI_ATTR_APPCTX_LIST, error_handle);
```

Note that `ctxl_desc` is `(OCIPParam *)` type.

3. Call `OCIParamGet` with the application context list descriptor to obtain an individual descriptor for the *i*-th application context:

```
OCIParamGet(ctxl_desc, OCI_DTYPE_PARAM, error_handle, (dvoid **)&ctx_desc, i);
```

Note that `ctx_desc` is `(OCIPParam *)` type.

4. Call `OCIAttrSet` with each of the three new attributes, `OCI_ATTR_APPCTX_NAME`, `OCI_ATTR_APPCTX_ATTR`, and `OCI_ATTR_APPCTX_VALUE`, to set the proper values in the application context:

```
OCIAttrSet(ctx_desc, OCI_DTYPE_PARAM,
           (dvoid *)ctx_name, sizeof(ctx_name), OCI_ATTR_APPCTX_NAME,
           error_handle);
```

```
OCIAttrSet(ctx_desc, OCI_DTYPE_PARAM,
           (dvoid *)attr_name, sizeof(attr_name), OCI_ATTR_APPCTX_ATTR,
           error_handle);
```

```
OCIAttrSet(ctx_desc, OCI_DTYPE_PARAM,
           (dvoid *)value, sizeof(value), OCI_ATTR_APPCTX_VALUE,
           error_handle);
```

Note that only character type is supported, because application context operations are based on the `VARCHAR2` type.

B.3.3 Example: Using Oracle Call Interface with the `SYS_CONTEXT` Function

You can create an OCI call that uses an externalized `SYS_CONTEXT` function with Oracle Label Security.

[Example B-1](#) shows how to accomplish this.

Example B-1 Using OCI to Externalize `SYS_CONTEXT` with OLS

```
#ifndef RCSID
static char *RCSid =
    "$Header: ext_mls.c 09-may-00.10:07:08 jdoe Exp $ ";
#endif /* RCSID */

/* Copyright (c) Oracle Corporation 1999, 2000. All Rights Reserved. */

/*

NAME
ext_mls.c - externalized SYS_CONTEXT with Label Security

DESCRIPTION
Run olddemo.sql script before executing this example.
Usage: <executable obtained with .c file> <user_name> <password> <session-initial-label>
Example: avg_sal sa_demo sa_demo L3:M,E:D10

PUBLIC FUNCTION(S)
<list of external functions declared/defined - with one-line descriptions>
```

```

PRIVATE FUNCTION(S)
<list of static functions defined in .c file - with one-line descriptions>

RETURNS
The average salary in the EMP table of the SA_DEMO schema querying as the specified user
with the specified session label.

NOTES
<other useful comments, qualifications, and so on>

MODIFIED   (MM/DD/YY)
jlev      09/18/03 - cleanup
jdoe      05/09/00 - cleanup
          10/13/99 - standalone OCI program to test MLS SYS_CONTEXT
jdoe      10/13/99 - Creation

*/
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <oci.h>

static OCIEnv *envhp;
static OCIError *errhp;

int main(/*_ int argc, char *argv[] _*/);

/* get and print error */
static void checkerr(/*_OCIError *errhp, sword status _*/);
/* print error */
static void printerr(char *call);
static sword status;

/* return the average of employees' salary */
static CONST text *const selectstmt = (text *)
    "select avg(sal) from sa_demo.emp";

int main(argc, argv)
int argc;
char *argv[];
{
    OCISession *authp = (OCISession *) 0;
    OCIError *errhp;
    OCIEnv *envhp;
    OCISvcCtx *svchp;
    OCIDefine *defnp = (OCIDefine *) 0;
    dvoid *parmdp;
    ub4 ctxsize;
    OCIParam *ctxldesc;
    OCIParam *ctxedesc;
    OCISstmt *stmp = (OCISstmt *) 0;
    ub4 avg_sal = 0;
    sword status;

    if (OCIInitialize((ub4) OCI_DEFAULT, (dvoid *) 0,
                    (dvoid * (*)(dvoid *, size_t)) 0,
                    (dvoid * (*)(dvoid *, dvoid *, size_t)) 0,
                    (void (*)(dvoid *, dvoid *)) 0))
        printerr("OCIInitialize");

    if (OCIEnvInit((OCIEnv **) &envhp, OCI_DEFAULT, (size_t) 0, (dvoid **) 0))
        printerr("OCIEnvInit");
}

```

```

if (OCIHandleAlloc((dvoid *) envhp, (dvoid **) &errhp, OCI_HTYPE_ERROR,
                  (size_t) 0, (dvoid **) 0))
    printerr("OCIHandleAlloc:OCI_HTYPE_ERROR");

if (OCIHandleAlloc((dvoid *) envhp, (dvoid **) &srvhp, OCI_HTYPE_SERVER,
                  (size_t) 0, (dvoid **) 0))
    printerr("OCIHandleAlloc:OCI_HTYPE_SERVER");

if (OCIHandleAlloc((dvoid *) envhp, (dvoid **) &svchp, OCI_HTYPE_SVCCTX,
                  (size_t) 0, (dvoid **) 0))
    printerr("OCIHandleAlloc:OCI_HTYPE_SVCCTX");

if (OCIServerAttach(srvhp, errhp, (text *) "", strlen(""), 0))
    printerr("OCIServerAttach");

/* set attribute server context in the service context */
if (OCIAttrSet((dvoid *) svchp, OCI_HTYPE_SVCCTX, (dvoid *) srvhp,
              (ub4) 0, OCI_ATTR_SERVER, (OCIError *) errhp))
    printerr("OCIAttrSet:OCI_HTYPE_SVCCTX");

if (OCIHandleAlloc((dvoid *) envhp, (dvoid **) &authp,
                  (ub4) OCI_HTYPE_SESSION, (size_t) 0, (dvoid **) 0))
    printerr("OCIHandleAlloc:OCI_HTYPE_SESSION");

/* set application context to 1 */
ctxsize = 1;

/* set up app ctx buffer */
if (OCIAttrSet((dvoid *) authp, (ub4) OCI_HTYPE_SESSION, (dvoid *) &ctxsize,
              (ub4) 0, (ub4) OCI_ATTR_APPCTX_SIZE, errhp))
    printerr("OCIAttrSet:OCI_ATTR_APPCTX_SIZE");

/* retrieve the list descriptor */
if (OCIAttrGet((dvoid *) authp, (ub4) OCI_HTYPE_SESSION,
              (dvoid *) &ctxldesc, 0, OCI_ATTR_APPCTX_LIST, errhp))
    printerr("OCIAttrGet:OCI_ATTR_APPCTX_LIST");

if (status = OCIParamGet(ctxldesc, OCI_DTYPE_PARAM, errhp,
                        (dvoid **) &ctxedesc, 1))
    {
        if (status == OCI_NO_DATA)
            {
                printf("No Data found!\n");
                exit(1);
            }
    }

/* set context namespace to SA$<pol_name>_X */
if (OCIAttrSet((dvoid *) ctxedesc, (ub4) OCI_DTYPE_PARAM,
              (dvoid *) "SA$HUMAN_RESOURCES_X",
              (ub4) strlen((char *) "SA$HUMAN_RESOURCES_X"),
              (ub4) OCI_ATTR_APPCTX_NAME, errhp))
    printerr("OCIAttrSet:OCI_ATTR_APPCTX_NAME:SA$HUMAN_RESOURCES_X");

/* set context attribute to INITIAL_LABEL */
if (OCIAttrSet((dvoid *) ctxedesc, (ub4) OCI_DTYPE_PARAM,
              (dvoid *) "INITIAL_LABEL",
              (ub4) strlen((char *) "INITIAL_LABEL"),
              (ub4) OCI_ATTR_APPCTX_ATTR, errhp))
    printerr("OCIAttrSet:OCI_DTYPE_PARAM:INITIAL_LABEL");

/* set context value to argv[3] - initial label */

```

```

if (OCIAttrSet((dvoid *) ctxedesc, (ub4) OCI_DTYPE_PARAM,
              (dvoid *) argv[3],
              (ub4) strlen((char *) argv[3]),
              (ub4) OCI_ATTR_APPCTX_VALUE, errhp))
    printerr("OCIAttrSet:argv[3]");

/* username first command line argument */
if (OCIAttrSet((dvoid *) authp, (ub4) OCI_HTYPE_SESSION, (dvoid *) argv[1],
              (ub4) strlen((char *) argv[1]), (ub4) OCI_ATTR_USERNAME,
              errhp))
    printerr("OCIAttrSet:username");

/* password second command line argument */
if (OCIAttrSet((dvoid *) authp, (ub4) OCI_HTYPE_SESSION, (dvoid *) argv[2],
              (ub4) strlen((char *) argv[2]), (ub4) OCI_ATTR_PASSWORD,
              errhp))
    printerr("OCIAttrSet:password");

if (OCISessionBegin(svchp, errhp, authp, OCI_CRED_RDBMS, (ub4) OCI_DEFAULT))
    printerr("OCISessionBegin");

if (OCIAttrSet((dvoid *) svchp, (ub4) OCI_HTYPE_SVCCTX, (dvoid *) authp,
              (ub4) 0, (ub4) OCI_ATTR_SESSION, errhp))
    printerr("OCIAttrSet:OCI_ATTR_SESSION");

if (OCIHandleAlloc((dvoid *) envhp, (dvoid **) &stmp, OCI_HTYPE_STMT,
                  0, 0))
    printerr("OCIHandleAlloc:OCI_HTYPE_STMT");

if (OCIStmtPrepare(stmp, errhp, (CONST OraText *) selectstmt,
                  (ub4) strlen((const char *) selectstmt),
                  (ub4) OCI_NTV_SYNTAX, (ub4) OCI_DEFAULT))
    printerr("OCIStmtPrepare");

if (OCIDefineByPos(stmp, &defnp, errhp, (ub4) 1, (dvoid *) &avg_sal,
                  (sb4) sizeof(avg_sal), SQLT_INT, 0, 0, 0, OCI_DEFAULT))
    printerr("OCIDefineByPos");

if (status = OCIStmtExecute(svchp, stmp, errhp, 1, 0, NULL, NULL,
                          OCI_DEFAULT))
    {
        if (status == OCI_NO_DATA)
            {
                printf("No Data found!\n");
                exit(1);
            }
    }

if (OCISessionEnd(svchp, errhp, authp, OCI_DEFAULT))
    printerr("OCISessionEnd");

printf("average salary is: %d\n", avg_sal);
}

void checkerr(errhp, status)
    OCIError *errhp;
    sword status;
{
    text errbuf[512];
    sb4 errcode = 0;

    switch (status)

```

```
{
  case OCI_ERROR:
    (void) OCIErrorGet((dvoid *) errhp, 1, NULL, &errcode, errbuf,
                      (ub4) sizeof(errbuf), OCI_HTYPE_ERROR);
    printf("Error - %.*s\n", 512, errbuf);
    break;
  default:
    break;
}
}

void printerr(call)
  char *call;
{
  printf("Error: %s\n", call);
}
/* end of file ext_mls.c */
```

C

Oracle Label Security in an Oracle RAC Environment

You can use Oracle Label Security in an Oracle Real Application Clusters (Oracle RAC) environment.

- [Oracle Label Security Policy Functions in an Oracle RAC Environment](#)
Policy changes made on one instance are available to other instances in the Oracle Real Application Clusters (Oracle RAC) environment immediately.
- [Transparent Application Failover in Oracle Label Security](#)
Session information is preserved on Transparent Application Failover.

C.1 Oracle Label Security Policy Functions in an Oracle RAC Environment

Policy changes made on one instance are available to other instances in the Oracle Real Application Clusters (Oracle RAC) environment immediately.

It is not necessary to restart the other instances to pick up the changes.

Important changes made on one database instance are automatically propagated to the other instances. One example would be creating a new policy. Another would be altering the policy options.

Propagating such changes ensures two valuable protections:

- That all users of the table are subject to the same policy
- That if any instance fails, continuation of its work by other instances will use the same policies and parameters that were in force immediately prior to that failure. So, if a policy had been enabled or disabled, it would be seen as such in all instances.

If an administrator changes policy information in one instance by using the policy functions listed in [Table C-1](#), Oracle Label Security stores the relevant information about whatever that function call changed. The new information is immediately available to the other active instances in the Oracle RAC, enabling uniformity among users of the affected policies.

Table C-1 Policy Functions Preserving Status in an Oracle RAC Environment

Policy Functions	Description
SA_SYSDBA.CREATE_POLICY	Creates a new policy
SA_SYSDBA.DROP_POLICY	Drops an existing policy
SA_SYSDBA.ENABLE_POLICY	Enables an existing policy
SA_SYSDBA.DISABLE_POLICY	Disables an existing policy
SA_SYSDBA.ALTER_POLICY	Alters an existing policy

C.2 Transparent Application Failover in Oracle Label Security

Session information is preserved on Transparent Application Failover.

Any changes to the session's information by way of session functions listed in [Table C-2](#) are preserved on Transparent Application Failover.

For example, suppose a user SCOTT is logged on with default label `Top Secret`. If the user calls `sa_session.set_label()` to change their session label to `Secret`, and a failover to another instance occurs, they will see no change but their session label remains `Secret`.

Preserving current user session information means that the access permissions and restrictions on what data that user can see or affect remain as they were. Despite the failover, the user can see and affect only the tables and rows accessible before the failover. If preservation were not the case, failing over to another instance could cause or enable the user to see a different set of data.

Whenever one of the session functions listed in [Table C-2](#) is used, Oracle Label Security stores the relevant information about whatever was changed by that function call.

Table C-2 Session Functions Preserving Status in an Oracle RAC Environment

Session Functions	Description
<code>SA_SESSION.SET_LABEL</code>	Lets the user set a new level and new compartments and groups to which they have read access
<code>SA_SESSION.SET_ROW_LABEL</code>	Lets the user set the default row label that will be applied to new rows
<code>SA_SESSION.SAVE_DEFAULT_LABELS</code>	Lets the user store the current session label and row label as the default for future sessions
<code>SA_SESSION.RESTORE_DEFAULT_LABELS</code>	Lets the user reset the current session label and row label to the stored default settings
<code>SA_SESSION.SET_ACCESS_PROFILE</code>	Sets the Oracle Label Security authorizations and privileges of the database session to those of the specified user

D

Oracle Label Security PL/SQL Packages

Oracle Label Security provides a set of PL/SQL packages.

- [SA_AUDIT_ADMIN Oracle Label Security Auditing PL/SQL Package](#)
For a non-unified auditing environment, the `SA_AUDIT_ADMIN` PL/SQL package configures auditing that is specific to Oracle Label Security.
- [SA_COMPONENTS Label Components PL/SQL Package](#)
The `SA_COMPONENTS` PL/SQL package manages the component definitions of an Oracle Label Security label.
- [SA_LABEL_ADMIN Label Management PL/SQL Package](#)
The `SA_LABEL_ADMIN` PL/SQL package provides an administrative interface to manage the labels used by a policy.
- [SA_POLICY_ADMIN Policy Administration PL/SQL Package](#)
The `SA_POLICY_ADMIN` PL/SQL package manages Oracle Label Security policies as a whole.
- [SA_SESSION Session Management PL/SQL Package](#)
The `SA_SESSION` PL/SQL package manages session behavior for user authorizations.
- [SA_SYSDBA Policy Management PL/SQL Package](#)
The `SA_SYSDBA` PL/SQL package manages Oracle Label Security policies.
- [SA_USER_ADMIN PL/SQL Package](#)
The `SA_USER_ADMIN` PL/SQL package manages user labels by label component.
- [SA_UTL PL/SQL Utility Functions and Procedures](#)
The `SA_UTL` PL/SQL package contains utility functions and procedures that are used in PL/SQL programs.



See Also:

[Using Dominance Functions](#) for additional standalone Oracle Label Security functions

D.1 SA_AUDIT_ADMIN Oracle Label Security Auditing PL/SQL Package

For a non-unified auditing environment, the `SA_AUDIT_ADMIN` PL/SQL package configures auditing that is specific to Oracle Label Security.

- [About the SA_AUDIT_ADMIN PL/SQL Package](#)
The `SA_AUDIT_ADMIN` PL/SQL package configures traditional auditing for labels and policies, as well as creating an auditing-related view.

- [SA_AUDIT_ADMIN.AUDIT_LABEL_ENABLED](#)
The `SA_AUDIT_ADMIN.AUDIT_LABEL_ENABLED` function shows whether labels are being recorded in audit records for the policy.
- [SA_AUDIT_ADMIN.CREATE_VIEW](#)
The `SA_AUDIT_ADMIN.CREATE_VIEW` procedure creates an audit trail view named `DBA_policyname_AUDIT_TRAIL`.
- [SA_AUDIT_ADMIN.DROP_VIEW](#)
The `SA_AUDIT_ADMIN.DROP_VIEW` procedure drops the audit trail view for the specified policy.
- [SA_AUDIT_ADMIN.NOAUDIT](#)
The `SA_AUDIT_ADMIN.NOAUDIT` procedure disables Oracle Label Security policy-specific auditing.
- [SA_AUDIT_ADMIN.NOAUDIT_LABEL](#)
The `SA_AUDIT_ADMIN.NOAUDIT_LABEL` procedure disables the auditing of policy labels.

D.1.1 About the SA_AUDIT_ADMIN PL/SQL Package

The `SA_AUDIT_ADMIN` PL/SQL package configures traditional auditing for labels and policies, as well as creating an auditing-related view.

Starting in Oracle Database release 23ai, traditional auditing is desupported. However, the `SA_AUDIT_ADMIN` package is retained so that you can disable any Oracle Label Security policies that still have traditional auditing enabled. The following procedures in this package have been disabled:

- `SA_AUDIT_ADMIN.AUDIT`
- `SA_AUDIT_ADMIN.AUDIT_LABEL`

Related Topics

- [Auditing Oracle Label Security Using Unified Auditing](#)
Oracle recommends that you migrate all your Oracle Label Security audit policies to unified auditing.
- [Duties of Oracle Label Security Administrators](#)
Oracle Label Security administrators have a set of package- and role-based privileges.

D.1.2 SA_AUDIT_ADMIN.AUDIT_LABEL_ENABLED

The `SA_AUDIT_ADMIN.AUDIT_LABEL_ENABLED` function shows whether labels are being recorded in audit records for the policy.

Syntax

```
SA_AUDIT_ADMIN.AUDIT_LABEL_ENABLED (
  policy_name IN VARCHAR2)
RETURN BOOLEAN;
```

Parameters

Table D-1 SA_AUDIT_ADMIN.AUDIT_LABEL_ENABLED Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example writes output indicating whether the Oracle Label Security labels are being audited for the hr_ols_pol policy.

```
SET SERVEROUTPUT ON
BEGIN
  IF SA_AUDIT_ADMIN.AUDIT_LABEL_ENABLED('hr_ols_pol')
    THEN DBMS_OUTPUT.PUT_LINE('OLS hr_ols_pol labels are being audited.');
```

```
  ELSE
    DBMS_OUTPUT.PUT_LINE('OLS hr_ols_pol labels not being audited.');
```

```
  END IF;
```

```
END;
```

```
/
```

D.1.3 SA_AUDIT_ADMIN.CREATE_VIEW

The SA_AUDIT_ADMIN.CREATE_VIEW procedure creates an audit trail view named DBA_policyname_AUDIT_TRAIL.

This view contains the specified policy's label column as well as all the entries in the audit trail written on behalf of this policy. If the view name exceeds the database limit of 30 characters, then the user can optionally specify a shorter view name.

Oracle Label Security grants the READ privilege on the DBA_policyname_AUDIT_TRAIL view to the Oracle Label Security policy database administrator.



See Also:

[Oracle Label Security User-Created Auditing View](#) to find the columns that are contained in the DBA_policyname_AUDIT_TRAIL view

Syntax

```
SA_AUDIT_ADMIN.CREATE_VIEW (
  policy_name      IN VARCHAR2,
  view_name        IN VARCHAR2   DEFAULT NULL);
```

Parameters

Table D-2 SA_AUDIT_ADMIN.CREATE_VIEW Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
view_name	Optional. Specifies the name of the view name. If you omit this setting, then the name defaults to DBA_policyname_AUDIT_TRAIL.

Examples

The following example creates a view called hr_ols_pol_view for the hr_ols_pol policy.

```
BEGIN
  SA_AUDIT_ADMIN.CREATE_VIEW(
    policy_name => 'hr_ols_pol',
    view_name   => 'hr_ols_pol_view');
END;
/
```

D.1.4 SA_AUDIT_ADMIN.DROP_VIEW

The SA_AUDIT_ADMIN.DROP_VIEW procedure drops the audit trail view for the specified policy.

Syntax

```
SA_AUDIT_ADMIN.DROP_VIEW (
  policy_name  IN VARCHAR2,
  view_name    IN VARCHAR2  DEFAULT NULL);
```

Parameters

Table D-3 SA_AUDIT_ADMIN.DROP_VIEW Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
view_name	Specifies an existing view's name. You can find this view by first querying the ALL_SA_POLICIES data dictionary view to find the name of the policy on which the view was based, and then querying ALL_VIEWS data dictionary view to find any views that have the name of the policy.

Example

The following example drops the view called hr_ols_pol_view from the hr_ols_pol policy.

```
BEGIN
  SA_AUDIT_ADMIN.DROP_VIEW(
    policy_name => 'hr_ols_pol',
    view_name   => 'hr_ols_pol_view');
END;
/
```

D.1.5 SA_AUDIT_ADMIN.NOAUDIT

The `SA_AUDIT_ADMIN.NOAUDIT` procedure disables Oracle Label Security policy-specific auditing.

Syntax

```
SA_AUDIT_ADMIN.NOAUDIT (
    policy_name      IN VARCHAR2,
    users            IN VARCHAR2 DEFAULT NULL,
    audit_option     IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-4 SA_AUDIT_ADMIN.NO_AUDIT Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>users</code>	Optional. A comma-delimited list of users who were audited. If not specified, then auditing is disabled for all users. To find users who have privileges to modify Oracle Label Security policies, query the <code>USER_NAME</code> column of the <code>ALL_SA_AUDIT_OPTIONS</code> view.
<code>audit_option</code>	Optional. A comma-delimited list of options to be disabled. Options are as follows: <ul style="list-style-type: none"> <code>APPLY</code>: Disables auditing of the application of specified Oracle Label Security policies to tables and schemas <code>REMOVE</code>: Disables auditing of the removal of specified Oracle Label Security policies from tables and schemas <code>SET</code>: Disables auditing of the setting of user authorizations, and user and program privileges <code>PRIVILEGES</code>: Disables auditing of the use of all policy-specific privileges If not specified, then all default options are disabled. Privileges must be disabled explicitly.

Examples

The following example disables auditing for failed `APPLY` and `REMOVE` attempts by the users `psmith` and `rlayton`.

```
BEGIN
  SA_AUDIT_ADMIN.NOAUDIT(
    policy_name => 'hr_ols_pol',
    users       => 'jjones',
    audit_option => 'apply, remove');
END;
/
```

You can disable auditing for all enabled options, or only for a subset of enabled options. All auditing for the specified options is disabled for all specified users (or all users, if the `users` parameter is `NULL`). For example, the following statement disables auditing of the `APPLY` and `REMOVE` operations for users John, Mary, and Scott:

```
EXEC SA_AUDIT_ADMIN.NOAUDIT ('HR', 'JOHN, MARY, SCOTT', 'APPLY, REMOVE');
```

Consider also a case in which one `AUDIT` call enables auditing for a specific user, and a second call (with no user specified) enables auditing for all users. For example:

```
EXEC SA_AUDIT_ADMIN.AUDIT ('HR', 'SCOTT');
EXEC SA_AUDIT_ADMIN.AUDIT ('HR');
```

In this case, a subsequent call to `NOAUDIT` with no users specified (such as the following statement) does not reverse the auditing that was set for `SCOTT` explicitly in the first call. So, auditing continues to be performed on `SCOTT`.

```
EXEC SA_AUDIT_ADMIN.NOAUDIT ('HR');
```

In this way, even if `SA_AUDIT_ADMIN.NOAUDIT` is set for all users, Oracle Label Security still audits any users for whom auditing was explicitly set.

Auditing of privileged operations must be specified explicitly. If you run `SA_AUDIT_ADMIN.NOAUDIT` with no options, the Oracle Label Security will nonetheless continue to audit privileged operations. For example, if auditing is enabled and you enter

```
EXEC SA_AUDIT_ADMIN.NOAUDIT ('HR');
```

then auditing will continue to be performed on the privileged operations (such as `WRITEDOWN`).

`SA_AUDIT_ADMIN.NOAUDIT` parameters and options that you set apply only to subsequent sessions, not to current sessions.

If you try to enable an audit option that has already been set, or if you try to disable an audit option that has not been set, then Oracle Label Security processes the statement without indicating an error. An attempt to specify an invalid option results in an error message. You can find the status of audit options by querying the `ALL_SA_AUDIT_OPTIONS` data dictionary view.

D.1.6 SA_AUDIT_ADMIN.NOAUDIT_LABEL

The `SA_AUDIT_ADMIN.NOAUDIT_LABEL` procedure disables the auditing of policy labels.

Syntax

```
SA_AUDIT_ADMIN.NOAUDIT_LABEL (
    policy_name      IN VARCHAR2);
```

Parameters

Table D-5 SA_AUDIT_ADMIN.NO_AUDIT_LABEL Parameter

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example disables auditing for the `hr_ols_pol` policy.

```
BEGIN
    SA_AUDIT_ADMIN.NOAUDIT_LABEL(
        policy_name      => 'hr_ols_pol');
```

```
END;  
/
```

D.2 SA_COMPONENTS Label Components PL/SQL Package

The SA_COMPONENTS PL/SQL package manages the component definitions of an Oracle Label Security label.

- [About the SA_COMPONENTS PL/SQL Package](#)
The SA_COMPONENTS PL/SQL package configures compartments, groups, parent groups, and levels.
- [SA_COMPONENTS.ALTER_COMPARTMENT](#)
The SA_COMPONENTS.ALTER_COMPARTMENT procedure changes the short name and long name associated with a compartment.
- [SA_COMPONENTS.ALTER_GROUP](#)
The SA_COMPONENTS.ALTER_GROUP procedure changes the short name and long name associated with a group.
- [SA_COMPONENTS.ALTER_GROUP_PARENT](#)
The SA_COMPONENTS.ALTER_GROUP_PARENT procedure changes the parent group associated with a particular group.
- [SA_COMPONENTS.ALTER_LEVEL](#)
The SA_COMPONENTS.ALTER_LEVEL procedure changes the short name and long name associated with a level.
- [SA_COMPONENTS.CREATE_COMPARTMENT](#)
The SA_COMPONENTS.CREATE_COMPARTMENT procedure creates a compartment and specify its short name and long name.
- [SA_COMPONENTS.CREATE_GROUP](#)
The SA_COMPONENTS.CREATE_GROUP procedure creates a group and specify its short name and long name, and optionally a parent group.
- [SA_COMPONENTS.CREATE_LEVEL](#)
The SA_COMPONENTS.CREATE_LEVEL procedure creates a level and specify its short name and long name.
- [SA_COMPONENTS.DROP_COMPARTMENT](#)
The SA_COMPONENTS.DROP_COMPARTMENT procedure removes a compartment.
- [SA_COMPONENTS.DROP_GROUP](#)
The SA_COMPONENTS.DROP_GROUP procedure removes a group.
- [SA_COMPONENTS.DROP_LEVEL](#)
The SA_COMPONENTS.DROP_LEVEL procedure removes a level.

D.2.1 About the SA_COMPONENTS PL/SQL Package

The SA_COMPONENTS PL/SQL package configures compartments, groups, parent groups, and levels.

To use this package, you must be granted the *policy_DBA* role (for example, HR_OLS_POL_DBA for a role for the hr_ols_pol policy) and the EXECUTE privilege on the SA_COMPONENTS package.

Related Topics

- [Understanding Data Labels and User Labels](#)
You should understand fundamental concepts of data labels and user labels.

D.2.2 SA_COMPONENTS.ALTER_COMPARTMENT

The `SA_COMPONENTS.ALTER_COMPARTMENT` procedure changes the short name and long name associated with a compartment.

Once set, the `comp_num` parameter cannot be changed. If the `comp_num` parameter is used in any existing label, then its short name *cannot* be changed but its long name *can* be changed.

Syntax

```
SA_COMPONENTS.ALTER_COMPARTMENT (
    policy_name      IN VARCHAR2,
    comp_num         IN NUMBER(38),
    new_short_name   IN VARCHAR2,
    new_long_name    IN VARCHAR2);

SA_COMPONENTS.ALTER_COMPARTMENT (
    policy_name      IN VARCHAR2,
    short_name       IN VARCHAR2 DEFAULT NULL,
    new_long_name    IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-6 SA_COMPONENTS.ALTER_COMPARTMENT Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>comp_num</code>	Specifies the number of the compartment to be altered. To find a list of existing compartment numbers, query the <code>COMP_NUM</code> column of the <code>ALL_SA_COMPARTMENTS</code> view.
<code>short_name</code>	Specifies the short name of the compartment to be altered (up to 30 characters). To find the current compartment, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_COMPARTMENTS</code> view.
<code>new_short_name</code>	Specifies the new short name of the compartment (up to 30 characters)
<code>new_long_name</code>	Specifies the new long name of the compartment (up to 80 characters).

Example

The following example modifies the `hr_ols_pol` policy.

```
BEGIN
    SA_COMPONENTS.ALTER_COMPARTMENT (
        policy_name      => 'hr_ols_pol',
        comp_num         => '48',
        new_short_name   => 'FIN',
        new_long_name    => 'FINANCE');
END;
/
```

D.2.3 SA_COMPONENTS.ALTER_GROUP

The `SA_COMPONENTS.ALTER_GROUP` procedure changes the short name and long name associated with a group.

Once set, the `group_num` parameter cannot be changed. If the group is used in any existing label, then its short name *cannot* be changed, but its long name *can* be changed.

Syntax

```
SA_COMPONENTS.ALTER_GROUP (
  policy_name      IN VARCHAR2,
  group_num        IN NUMBER(38),
  new_short_name   IN VARCHAR2 DEFAULT NULL,
  new_long_name    IN VARCHAR2 DEFAULT NULL);
```

```
SA_COMPONENTS.ALTER_GROUP (
  policy_name      IN VARCHAR2,
  short_name       IN VARCHAR2,
  new_long_name    IN VARCHAR2);
```

Parameters

Table D-7 SA_COMPONENTS.ALTER_GROUP Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>group_num</code>	Specifies the existing group number to be altered. To find existing group numbers, query the <code>GROUP_NUM</code> column of the <code>ALL_SA_GROUPS</code> view.
<code>short_name</code>	Specifies the existing group short name to be altered. To find existing short names, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_GROUPS</code> view.
<code>new_short_name</code>	Specifies the new short name for the group (up to 30 characters)
<code>new_long_name</code>	Specifies the new long name for the group (up to 80 characters)

Example

The following example modifies the `long_name` setting for the `hr_ols_pol` policy.

```
BEGIN
  SA_COMPONENTS.ALTER_GROUP (
    policy_name      => 'hr_ols_pol',
    short_name       => 'ER_FIN',
    new_long_name    => 'ER_FINANCES');
END;
/
```

D.2.4 SA_COMPONENTS.ALTER_GROUP_PARENT

The `SA_COMPONENTS.ALTER_GROUP_PARENT` procedure changes the parent group associated with a particular group.

Syntax

```
SA_COMPONENTS.ALTER_GROUP_PARENT (
  policy_name      IN VARCHAR2,
  group_num        IN NUMBER(38),
  new_parent_num   IN NUMBER(38));
```

```
SA_COMPONENTS.ALTER_GROUP_PARENT (
  policy_name      IN VARCHAR2,
  group_num        IN NUMBER(38),
  new_parent_name  IN VARCHAR2);
```

```
SA_COMPONENTS.ALTER_GROUP_PARENT (
  policy_name      IN VARCHAR2,
  short_name       IN VARCHAR2,
  new_parent_name  IN VARCHAR2);
```

Parameters

Table D-8 SA_COMPONENTS.ALTER_GROUP_PARENT Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>group_num</code>	Specifies the existing group number to be altered. To find existing group numbers, query the <code>GROUP_NUM</code> column of the <code>ALL_SA_GROUPS</code> view.
<code>short_name</code>	Specifies the existing group short name to be altered. To find existing short names, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_GROUPS</code> view.
<code>new_parent_num</code>	Specifies the number of an existing group as the parent group. To find existing parent groups, query the <code>PARENT_NUM</code> column of the <code>ALL_SA_GROUPS</code> view.
<code>new_parent_name</code>	Specifies the short name of an existing group as the parent group. To find existing groups, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_GROUPS</code> view.

Example

The following example modifies the parent name for the `hr_ols_pol` policy.

```
BEGIN
  SA_COMPONENTS.ALTER_GROUP_PARENT (
    policy_name      => 'hr_ols_pol',
    group_num        => 2100,
    new_parent_name  => 'ER');
END;
/
```

D.2.5 SA_COMPONENTS.ALTER_LEVEL

The `SA_COMPONENTS.ALTER_LEVEL` procedure changes the short name and long name associated with a level.

Once they are defined, level numbers cannot be changed. If a level is used in any existing label, then its short name *cannot* be changed, but its long name *can* be changed.

Syntax

```
SA_COMPONENTS.ALTER_LEVEL (
  policy_name      IN VARCHAR2,
  level_num        IN NUMBER(38),
  new_short_name   IN VARCHAR2 DEFAULT NULL,
  new_long_name    IN VARCHAR2 DEFAULT NULL);
```

```
SA_COMPONENTS.ALTER_LEVEL (
  policy_name      IN VARCHAR2,
  short_name       IN VARCHAR2,
  new_long_name    IN VARCHAR2);
```

Parameters

Table D-9 SA_COMPONENTS.ALTER_LEVEL Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy, which must exist. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>level_num</code>	Specifies the number of the level to be altered. To find existing levels, query the <code>LEVEL_NUM</code> column of the <code>ALL_SA_LEVELS</code> view.
<code>short_name</code>	Specifies the existing short name of the level. To find existing level short names, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_LEVELS</code> view.
<code>new_short_name</code>	Specifies the new short name for the level (up to 30 characters)
<code>new_long_name</code>	Specifies the new long name for the level (up to 80 characters)

Example

The following example modifies the short and long names for the `hr_ols_pol` policy level.

```
BEGIN
  SA_COMPONENTS.ALTER_LEVEL (
    policy_name => 'hr_ols_pol',
    level_num   => 40,
    new_short_name => 'TS',
    new_long_name => 'TOP_SECRET');
END;
/
```

D.2.6 SA_COMPONENTS.CREATE_COMPARTMENT

The `SA_COMPONENTS.CREATE_COMPARTMENT` procedure creates a compartment and specify its short name and long name.

The `comp_num` parameter determines the order in which compartments are listed in the character string representation of labels.

Syntax

```
SA_COMPONENTS.CREATE_COMPARTMENT (
  policy_name IN VARCHAR2,
  comp_num    IN NUMBER(38),
  short_name  IN VARCHAR2,
  long_name   IN VARCHAR2);
```

Parameters

Table D-10 SA_COMPONENTS.CREATE_COMPARTMENT Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>comp_num</code>	Specifies the compartment number (0-9999)
<code>short_name</code>	Specifies the short name for the compartment (up to 30 characters)
<code>long_name</code>	Specifies the long name for the compartment (up to 80 characters)

Example

The following example creates a compartment for the `hr_ols_pol` policy.

```
BEGIN
  SA_COMPONENTS.CREATE_COMPARTMENT (
    policy_name => 'hr_ols_pol',
    comp_num    => '48',
    short_name  => 'FIN',
    long_name   => 'FINANCE');
END;
/
```

D.2.7 SA_COMPONENTS.CREATE_GROUP

The `SA_COMPONENTS.CREATE_GROUP` procedure creates a group and specify its short name and long name, and optionally a parent group.

Syntax

```
SA_COMPONENTS.CREATE_GROUP (
  policy_name IN VARCHAR2,
  group_num   IN NUMBER(38),
  short_name  IN VARCHAR2,
  long_name   IN VARCHAR2,
  parent_name IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-11 SA_COMPONENTS.CREATE_GROUP Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
group_num	Specifies the group number (0-9999)
short_name	Specifies the short name for the group (up to 30 characters)
long_name	Specifies the long name for the group (up to 80 characters)
parent_name	Specifies the short name of an existing group as the parent group. If NULL, then the group is a top-level group.

Note that the group number affects the order in which groups will be displayed when labels are selected.

Examples

In the following examples, the first creates a parent group, ER, and the second creates a second group that is part of the parent group.

```
BEGIN
  SA_COMPONENTS.CREATE_GROUP (
    policy_name => 'hr_ols_pol',
    group_num   => 2000,
    short_name  => 'ER',
    long_name   => 'EAST_REGION');
END;
/

BEGIN
  SA_COMPONENTS.CREATE_GROUP (
    policy_name   => 'hr_ols_pol',
    group_num     => 2100,
    short_name    => 'ER_FIN',
    long_name     => 'ER_FINANCES',
    parent_name   => 'ER');
END;
/
```

D.2.8 SA_COMPONENTS.CREATE_LEVEL

The SA_COMPONENTS.CREATE_LEVEL procedure creates a level and specify its short name and long name.

The numeric values assigned to the level_num parameter determine the sensitivity ranking (that is, a lower number indicates less sensitive data).

Syntax

```
SA_COMPONENTS.CREATE_LEVEL (
  policy_name   IN VARCHAR2,
  level_num     IN NUMBER(38),
  short_name    IN VARCHAR2,
  long_name     IN VARCHAR2);
```

Parameters

Table D-12 SA_COMPONENTS.CREATE_LEVEL Parameters

Parameter	Description
policy_name	Specifies the policy, which must exist. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
level_num	Specifies the level number (0-9999)
short_name	Specifies the short name for the level (up to 30 characters)
long_name	Specifies the long name for the level (up to 80 characters)

Example

The following example creates a level for the hr_ols_pol policy.

```
BEGIN
  SA_COMPONENTS.CREATE_LEVEL (
    policy_name => 'hr_ols_pol',
    level_num   => 40,
    short_name  => 'HS',
    long_name   => 'HIGHLY_SENSITIVE');
END;
/
```

D.2.9 SA_COMPONENTS.DROP_COMPARTMENT

The SA_COMPONENTS.DROP_COMPARTMENT procedure removes a compartment.

If the compartment is used in any existing label, then it *cannot* be dropped. You can find all existing labels by querying the LABEL column of the ALL_SA_DATA_LABELS data dictionary view.

Syntax

```
SA_COMPONENTS.DROP_COMPARTMENT (
  policy_name IN VARCHAR2,
  comp_num    IN INTEGER);

SA_COMPONENTS.DROP_COMPARTMENT (
  policy_name IN VARCHAR2,
  short_name  IN VARCHAR2);
```

Parameters

Table D-13 SA_COMPONENTS.DROP_COMPARTMENT Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
comp_num	Specifies the number of an existing compartment for the policy. To find existing compartment numbers, query the COMP_NUM column of the DBA_SA_COMPARTMENTS view.

Table D-13 (Cont.) SA_COMPONENTS.DROP_COMPARTMENT Parameters

Parameter	Description
short_name	Specifies the short name of an existing compartment for the policy. To find existing compartment short names, query the SHORT_NAME column of the DBA_SA_COMPARTMENTS view.

Example

The following example removes the FIN compartment from the hr_ols_pol policy.

```
BEGIN
  SA_COMPONENTS.DROP_COMPARTMENT (
    policy_name => 'hr_ols_pol',
    short_name  => 'FIN');
END;
/
```

D.2.10 SA_COMPONENTS.DROP_GROUP

The SA_COMPONENTS.DROP_GROUP procedure removes a group.

If the group is used in an existing label, then it cannot be dropped.

Syntax

```
SA_COMPONENTS.DROP_GROUP (
  policy_name IN VARCHAR2,
  group_num   IN NUMBER(38));

SA_COMPONENTS.DROP_GROUP (
  policy_name IN VARCHAR2,
  short_name  IN VARCHAR2);
```

Parameters

Table D-14 SA_COMPONENTS.DROP_GROUP Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
group_num	Specifies the number of an existing group for the policy. To find existing group numbers, query the GROUP_NUM column of the ALL_SA_GROUPS view.
short_name	Specifies the short name of an existing group. To find existing group short names, query the SHORT_NAME column of the ALL_SA_GROUPS view.

Example

The following example removes a group based on the group number for the hr_ols_pol policy.

```
BEGIN
  SA_COMPONENTS.DROP_GROUP (
    policy_name => 'hr_ols_pol',
```



```

        group_num      => 2000);
    END;
/

```

D.2.11 SA_COMPONENTS.DROP_LEVEL

The `SA_COMPONENTS.DROP_LEVEL` procedure removes a level.

If the level is used in any existing label, then it cannot be dropped.

Syntax

```

SA_COMPONENTS.DROP_LEVEL (
    policy_name IN VARCHAR2,
    level_num   IN NUMBER(38));

```

```

SA_COMPONENTS.DROP_LEVEL (
    policy_name IN VARCHAR2,
    short_name  IN VARCHAR2);

```

Parameters

Table D-15 SA_COMPONENTS.DROP_LEVEL Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy, which must exist. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>level_num</code>	Specifies the number of an existing level for the policy. To find existing level numbers, query the <code>LEVEL_NUM</code> column of the <code>ALL_SA_LEVELS</code> view.
<code>short_name</code>	Specifies the short name for the level (up to 30 characters). To find existing level short names, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_LEVELS</code> view.

Example

The following example drops the level 40 from the `hr_ols_pol` policy.

```

BEGIN
    SA_COMPONENTS.DROP_LEVEL (
        policy_name => 'hr_ols_pol',
        level_num   => 40);
END;
/

```

D.3 SA_LABEL_ADMIN Label Management PL/SQL Package

The `SA_LABEL_ADMIN` PL/SQL package provides an administrative interface to manage the labels used by a policy.

- [About the SA_LABEL_ADMIN PL/SQL Package](#)
The `SA_LABEL_ADMIN` PL/SQL package creates, alters, and deletes labels.
- [SA_LABEL_ADMIN.ALTER_LABEL](#)
The `SA_LABEL_ADMIN.ALTER_LABEL` procedure changes the character string label definition associated with a label tag.

- [SA_LABEL_ADMIN.CREATE_LABEL](#)
The SA_LABEL_ADMIN.CREATE_LABEL procedure creates data labels.
- [SA_LABEL_ADMIN.DROP_LABEL](#)
The SA_LABEL_ADMIN.DROP_LABEL procedure deletes a specified policy label.

D.3.1 About the SA_LABEL_ADMIN PL/SQL Package

The SA_LABEL_ADMIN PL/SQL package creates, alters, and deletes labels.

D.3.2 SA_LABEL_ADMIN.ALTER_LABEL

The SA_LABEL_ADMIN.ALTER_LABEL procedure changes the character string label definition associated with a label tag.

The label tag itself cannot be changed.

If you change the character string associated with a label tag, then the sensitivity of the data in the rows changes accordingly. For example, if the label character string TS:A with an associated label tag value of 4001 is changed to the label TS:B, then access to the data changes accordingly. This is true even when the label tag value (4001) has not changed. In this way, you can change the data's sensitivity without the need to update all the rows.

Ensure that when you specify a label to alter, you can refer to it either by its label tag or by its character string value.

Syntax

```
SA_LABEL_ADMIN.ALTER_LABEL (
    policy_name      IN VARCHAR2,
    label_tag        IN BINARY_INTEGER,
    new_label_value  IN VARCHAR2 DEFAULT NULL,
    new_data_label   IN BOOLEAN  DEFAULT NULL);
```

```
SA_LABEL_ADMIN.ALTER_LABEL (
    policy_name      IN VARCHAR2,
    label_value      IN VARCHAR2,
    new_label_value  IN VARCHAR2 DEFAULT NULL,
    new_data_label   IN BOOLEAN  DEFAULT NULL);
```

Parameters

Table D-16 SA_LABEL_ADMIN.ALTER_LABEL Parameters

Parameter	Description
policy_name	Specifies the name of an existing policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
label_tag	Identifies the integer tag assigned to the label to be altered. To find existing label tags, query the LABEL_TAG column of the ALL_SA_LABELS view.
label_value	Identifies the existing character string representation of the label to be altered. To find the existing label values, query the LABEL column of the ALL_SA_LABELS view.
new_label_value	Specifies the new character string representation of the label value. If NULL, the existing value is not changed.

Table D-16 (Cont.) SA_LABEL_ADMIN.ALTER_LABEL Parameters

Parameter	Description
new_data_label	TRUE if the label can be used to label row data. If NULL, the existing value is not changed.

Example

The following example modifies the label_tag and label_value settings of hr_ols_pol policy.

```
BEGIN
  SA_LABEL_ADMIN.ALTER_LABEL (
    policy_name      => 'hr_ols_pol',
    label_tag        => 1111,
    new_label_value  => 'HS',
    new_data_label   => TRUE);
END;
/
```

D.3.3 SA_LABEL_ADMIN.CREATE_LABEL

The SA_LABEL_ADMIN.CREATE_LABEL procedure creates data labels.

Syntax

```
SA_LABEL_ADMIN.CREATE_LABEL (
  policy_name IN VARCHAR2,
  label_tag   IN BINARY_INTEGER,
  label_value IN VARCHAR2,
  data_label  IN BOOLEAN DEFAULT TRUE);
```

Parameters

Table D-17 SA_LABEL_ADMIN.CREATE_LABEL Parameters

Parameter	Description
policy_name	Specifies the name of an existing policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
label_tag	Specifies a unique integer value representing the sort order of the label, relative to other policy labels (0-99999999). This value must be 1 to 8 digits long.
label_value	Specifies the character string representation of the label to be created. Use the short name of the level, compartment, and group. You can find these values by querying the SHORT_NAME column of the ALL_SA_LEVELS, ALL_SA_COMPARTMENTS, and ALL_SA_GROUPS views.
data_label	TRUE if the label can be used to label row data. Use this to define the label as valid for data.

When you identify valid labels, you specify which of all the possible combinations of levels, compartments, and groups can potentially be used to label data in tables.

Example

The following example creates a label for the `hr_ols_pol` policy.

```
BEGIN
  SA_LABEL_ADMIN.CREATE_LABEL (
    policy_name   => 'hr_ols_pol',
    label_tag     => 1111,
    label_value   => 'HS:FIN',
    data_label    => TRUE);
END;
/
```



Note:

If you create a new label by using the `TO_DATA_LABEL` procedure, then a system-generated label tag of 10 digits is generated automatically.

D.3.4 SA_LABEL_ADMIN.DROP_LABEL

The `SA_LABEL_ADMIN.DROP_LABEL` procedure deletes a specified policy label.

Any subsequent reference to the label (in data rows, or in user or program unit labels) will raise an invalid label error.

Use this procedure only while setting up labels, prior to data population. If you should inadvertently drop a label that is being used, you can recover it by disabling the policy, fixing the problem, and then re-enabling the policy.

Syntax

```
SA_LABEL_ADMIN.DROP_LABEL (
  policy_name   IN VARCHAR2,
  label_tag     IN BINARY_INTEGER);
```

```
SA_LABEL_ADMIN.DROP_LABEL (
  policy_name   IN VARCHAR2,
  label_value   IN VARCHAR2);
```

Parameters

Table D-18 SA_LABEL_ADMIN.DROP_LABEL Parameters

Parameter	Description
<code>policy_name</code>	Specifies the name of an existing policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>label_tag</code>	Specifies the integer tag assigned to the label to be dropped. To find existing label tags, query the <code>LABEL_TAG</code> column of the <code>ALL_SA_LABELS</code> view.
<code>label_value</code>	Specifies the string value of the label to be dropped. To find existing label values, query the <code>LABEL</code> column of the <code>ALL_SA_LABELS</code> view.

⚠ WARNING:

Do not drop a label that is in use anywhere in the database. You can find labels by querying the `ALL_SA_LABELS` data dictionary view.

Example

The following example drops the `hr_ols_pol` policy label based on its `label_tag` setting.

```
BEGIN
  SA_LABEL_ADMIN.DROP_LABEL (
    policy_name => 'hr_ols_pol',
    label_tag   => 1111);
END;
/
```

D.4 SA_POLICY_ADMIN Policy Administration PL/SQL Package

The `SA_POLICY_ADMIN` PL/SQL package manages Oracle Label Security policies as a whole.

- [About the SA_POLICY_ADMIN PL/SQL Package](#)
The `SA_POLICY_ADMIN` PL/SQL package configures schema and table policies, and performs subscribe and unsubscribe actions.
- [SA_POLICY_ADMIN.ALTER_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.ALTER_SCHEMA_POLICY` procedure changes the default enforcement options for the policy.
- [SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to all of the tables in a schema and enables the policy for these tables.
- [SA_POLICY_ADMIN.APPLY_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` procedure adds the specified policy to a table.
- [SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY` procedure disables the enforcement of the policy for all tables in a schema.
- [SA_POLICY_ADMIN.DISABLE_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.DISABLE_TABLE_POLICY` procedure disables the enforcement of the policy for a table without changing the enforcement options, labeling function, or predicate values.
- [SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY` procedure reenables the current enforcement options, labeling function, and predicate for the tables in the specified schema.
- [SA_POLICY_ADMIN.ENABLE_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.ENABLE_TABLE_POLICY` procedure reenables the current enforcement options, labeling function, and predicate for the specified table.
- [SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY` procedure removes the specified policy from a schema.

- [SA_POLICY_ADMIN.REMOVE_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.REMOVE_TABLE_POLICY` procedure removes the specified policy from a table.

D.4.1 About the SA_POLICY_ADMIN PL/SQL Package

The `SA_POLICY_ADMIN` PL/SQL package configures schema and table policies, and performs subscribe and unsubscribe actions.

To use this package, you must be granted the `policy_DBA` role (for example, `HR_OLS_POL_DBA` for a role for the `hr_ols_pol` policy) and the `EXECUTE` privilege for the `SA_POLICY_ADMIN` package.

D.4.2 SA_POLICY_ADMIN.ALTER_SCHEMA_POLICY

The `SA_POLICY_ADMIN.ALTER_SCHEMA_POLICY` procedure changes the default enforcement options for the policy.

Any new tables created in the schema will automatically have the new enforcement options applied. The existing tables in the schema are not affected.

To change enforcement options on a table (rather than a schema), you must first drop the policy from the table, make the change, and then reapply the policy.

If you alter the enforcement options on a schema, then this will take effect the next time a table is created in the schema. As a result, different tables within a schema may have different policy enforcement options in force.

Syntax

```
SA_POLICY_ADMIN.ALTER_SCHEMA_POLICY (
  policy_name      IN VARCHAR2,
  schema_name      IN VARCHAR2,
  default_options  IN VARCHAR2);
```

Parameters

Table D-19 SA_POLICY_ADMIN.ALTER_SCHEMA Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>schema_name</code>	The schema that contains the table. To find existing schemas associated with this policy, query the <code>POLICY_NAME</code> and <code>SCHEMA_NAME</code> columns of the <code>ALL_SA_TABLE_POLICIES</code> view.
<code>default_options</code>	The default options to be used for new tables in the schema. Separate each option with a comma. See Table 10-2 for a listing of the default enforcement options.

Example

The following example adds the `UPDATE_CONTROL` default option to the `HR` schema.

```
BEGIN
  SA_POLICY_ADMIN.ALTER_SCHEMA_POLICY (
    policy_name      => 'hr_ols_pol',
```

```

    schema_name      => 'HR',
    default_options  => 'read_control, write_control, update_control');
END;
/

```

D.4.3 SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY

The `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to all of the tables in a schema and enables the policy for these tables.

That is, it applies to those tables that do not already have the policy applied. Then, whenever a new table is created in the schema, the policy is automatically applied to that table, using the schema's default options. No changes are made to existing tables in the schema that already have the policy applied.

Syntax

```

SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY (
    policy_name      IN VARCHAR2,
    schema_name      IN VARCHAR2,
    default_options  IN VARCHAR2 DEFAULT NULL);

```

Parameters

Table D-20 SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>schema_name</code>	The schema that contains the table to protect
<code>default_options</code>	The default options to be used for tables in the schema. Separate each option with a comma. If the <code>default_options</code> parameter is <code>NULL</code> , then the policy's default options will be used to apply the policy to the tables in the schema. See Table 10-2 for a listing of the default enforcement options.

Example

The following example applies the `READ_CONTROL` and `WRITE_CONTROL` options to the `HR` schema.

```

BEGIN
    SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY(
        policy_name      => 'hr_ols_pol',
        schema_name      => 'HR',
        default_options  => 'read_control, write_control');
END;
/

```

D.4.4 SA_POLICY_ADMIN.APPLY_TABLE_POLICY

The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` procedure adds the specified policy to a table.

A policy label column is added to the table if it does not exist, and is set to `NULL`. When a policy is applied, it is automatically enabled. To change the table options, labeling function, or predicate, you must first remove the policy, and then reapply it.

Syntax

```
SA_POLICY_ADMIN.APPLY_TABLE_POLICY (
  policy_name      IN VARCHAR2,
  schema_name     IN VARCHAR2,
  table_name      IN VARCHAR2,
  table_options   IN VARCHAR2 DEFAULT NULL,
  label_function  IN VARCHAR2 DEFAULT NULL,
  predicate       IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-21 SA_POLICY_ADMIN.APPLY_TABLE_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
schema_name	The schema that contains the table that the policy protects
table_name	The table to be protected by the policy
table_options	A comma-delimited list of policy enforcement options to be used for the table. If NULL, then the policy's default options are used. See Table 10-2 for a listing of the default enforcement options.
label_function	A string calling a function to return a label value to use as the default. For example, my_label (:new.dept, :new.status) computes the label based on the new values of the DEPT and STATUS columns in the row.
predicate	An additional predicate to combine (using AND or OR) with the label-based predicate for READ_CONTROL

Example

The following statement applies the hr_ols_pol policy to the EMPLOYEES table in the HR schema.

```
BEGIN
  SA_POLICY_ADMIN.APPLY_TABLE_POLICY(
    policy_name => 'hr_ols_pol',
    schema_name => 'HR',
    table_name  => 'EMPLOYEES',
    table_options => NULL,
    label_function => 'hs (:new.dept, :new.status)',
    predicate   => 'no_control');
END;
/
```

D.4.5 SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY

The SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY procedure disables the enforcement of the policy for all tables in a schema.

However, it does not change the enforcement options, labeling function, or predicate values.

This procedure removes the row level security predicate and DML triggers from all the tables in the schema.

Syntax

```
SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY (
  policy_name   IN VARCHAR2,
  schema_name   IN VARCHAR2);
```

Parameters

Table D-22 SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
schema_name	The schema that contains the table for this policy. To find this schema, query the POLICY_NAME and SCHEMA_NAME columns of the ALL_SA_TABLE_POLICIES view.

Example

The following example disables the hr_ols_pol policy for the HR schema.

```
BEGIN
  SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY(
    policy_name   => 'hr_ols_pol',
    schema_name   => 'HR');
END;
/
```

D.4.6 SA_POLICY_ADMIN.DISABLE_TABLE_POLICY

The SA_POLICY_ADMIN.DISABLE_TABLE_POLICY procedure disables the enforcement of the policy for a table without changing the enforcement options, labeling function, or predicate values.

This procedure removes the row level security predicate and DML triggers from the table.

Syntax

```
SA_POLICY_ADMIN.DISABLE_TABLE_POLICY (
  policy_name   IN VARCHAR2,
  schema_name   IN VARCHAR2,
  table_name    IN VARCHAR2);
```

Parameters

Table D-23 SA_POLICY_ADMIN.DISABLE_TABLE_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
schema_name	The schema that contains the table. To find this schema, query the POLICY_NAME and SCHEMA_NAME columns of the ALL_SA_TABLE_POLICIES view.

Table D-23 (Cont.) SA_POLICY_ADMIN.DISABLE_TABLE_POLICY Parameters

Parameter	Description
table_name	The table in the schema specified by schema_name. To find this table, query the POLICY_NAME, SCHEMA_NAME, and TABLE_NAME columns of the ALL_SA_TABLE_POLICIES view.

Example

The following statement disables the hr_ols_pos policy on the EMPLOYEES table in the HR schema:

```
BEGIN
  SA_POLICY_ADMIN.DISABLE_TABLE_POLICY (
    policy_name => 'hr_ols_pol',
    schema_name => 'HR',
    table_name  => 'EMPLOYEES');
END;
/
```

D.4.7 SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY

The SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY procedure reenables the current enforcement options, labeling function, and predicate for the tables in the specified schema.

It accomplishes this by re-applying the row level security predicate and DML triggers. The result is similar to enabling a policy for a table, but it covers all the tables in the schema.

Syntax

```
SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY (
  policy_name  IN VARCHAR2,
  schema_name  IN VARCHAR2);
```

Parameters**Table D-24 SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY Parameters**

Parameter	Description
policy_name	Specifies the policy. To find existing policies and their status, query the POLICY_NAME and STATUS columns of the ALL_SA_POLICIES data dictionary view.
schema_name	The schema that contains the table. To find this schema, query the POLICY_NAME and SCHEMA_NAME columns of the ALL_SA_TABLE_POLICIES view.

Example

The following example enables the hr_ols_pol policy for the HR schema.

```
BEGIN
  SA_POLICY_ADMIN.ENABLE_SCHEMA_POLICY (
    policy_name => 'hr_ols_pol',
    schema_name => 'HR');
```

```
END;
/
```

D.4.8 SA_POLICY_ADMIN.ENABLE_TABLE_POLICY

The `SA_POLICY_ADMIN.ENABLE_TABLE_POLICY` procedure reenables the current enforcement options, labeling function, and predicate for the specified table.

It accomplishes this by reapplying the row level security predicate and DML triggers.

Syntax

```
SA_POLICY_ADMIN.ENABLE_TABLE_POLICY (
  policy_name      IN VARCHAR2,
  schema_name      IN VARCHAR2,
  table_name       IN VARCHAR2);
```

Parameters

Table D-25 SA_POLICY_ADMIN.ENABLE_TABLE_POLICY Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. <code>POLICY_NAME</code> and <code>STATUS</code> columns of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>schema_name</code>	The schema that contains the table. To find this schema, query the <code>POLICY_NAME</code> and <code>SCHEMA_NAME</code> columns of the <code>ALL_SA_TABLE_POLICIES</code> view.
<code>table_name</code>	The table in the schema specified by <code>schema_name</code> . To find this table, query the <code>POLICY_NAME</code> , <code>SCHEMA_NAME</code> , and <code>TABLE_NAME</code> columns of the <code>ALL_SA_TABLE_POLICIES</code> view.

Example

The following statement reenables the `hr_ols_pol` policy on the `EMPLOYEES` table in the `HR` schema:

```
BEGIN
  SA_POLICY_ADMIN.ENABLE_TABLE_POLICY(
    policy_name => 'hr_ols_pol',
    schema_name => 'HR',
    table_name  => 'EMPLOYEES');
END;
/
```

D.4.9 SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY

The `SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY` procedure removes the specified policy from a schema.

The policy will be removed from all the tables in the schema and, optionally, the label column for the policy will be dropped from all the tables.

Syntax

```
SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY (
  policy_name      IN VARCHAR2,
```

```

schema_name      IN VARCHAR2,
drop_column      IN BOOLEAN DEFAULT FALSE);

```

Parameters

Table D-26 SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
schema_name	The schema that contains the table associated with this policy. To find this schema, query the SCHEMA_NAME of the ALL_SA_SCHEMA_POLICIES view.
drop_column	If TRUE, then the policy's column will be dropped from the tables, otherwise, the column will remain.

Example

The following example drops the human_resource policy's column from the HR schema.

```

BEGIN
  SA_POLICY_ADMIN.REMOVE_SCHEMA_POLICY (
    policy_name      => 'hr_ols_pol',
    schema_name      => 'HR',
    drop_column      => TRUE);
END;
/

```

D.4.10 SA_POLICY_ADMIN.REMOVE_TABLE_POLICY

The SA_POLICY_ADMIN.REMOVE_TABLE_POLICY procedure removes the specified policy from a table.

The policy predicate and any DML triggers will be removed from the table, and the policy label column can optionally be dropped. Policies can be removed from tables belonging to a schema that is protected by the policy.

Syntax

```

SA_POLICY_ADMIN.REMOVE_TABLE_POLICY (
policy_name      IN VARCHAR2,
schema_name      IN VARCHAR2,
table_name       IN VARCHAR2,
drop_column      IN BOOLEAN DEFAULT FALSE);

```

Parameters

Table D-27 SA_POLICY_ADMIN.REMOVE_TABLE_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
schema_name	The schema that contains the table associated with this policy. To find this schema, query the SCHEMA_NAME of the ALL_SA_SCHEMA_POLICIES view.

Table D-27 (Cont.) SA_POLICY_ADMIN.REMOVE_TABLE_POLICY Parameters

Parameter	Description
table_name	The table in the schema specified by schema_name. To find this table query the POLICY_NAME, SCHEMA_NAME, and TABLE_NAME columns of the ALL_SA_TABLE_POLICIES view.
drop_column	Whether the column is to be dropped: if TRUE, then the policy's column will be dropped from the table, otherwise, it will remain

Example

The following statement removes the hr_ols_pol policy from the EMPLOYEES table in the HR schema:

```
BEGIN
  SA_POLICY_ADMIN.REMOVE_TABLE_POLICY(
    policy_name => 'hr_ols_pol',
    schema_name => 'HR',
    table_name  => 'EMPLOYEES',
    drop_column => TRUE);
END;
/
```

D.5 SA_SESSION Session Management PL/SQL Package

The SA_SESSION PL/SQL package manages session behavior for user authorizations.

- [About the SA_SESSION PL/SQL Package](#)
The SA_SESSION PL/SQL package manages user name, levels, labels, and read and write permissions for a user session.
- [SA_SESSION.COMP_READ](#)
The SA_SESSION.COMP_READ function returns a comma-delimited list of compartments that the user is authorized to read.
- [SA_SESSION.COMP_WRITE](#)
The SA_SESSION.COMP_WRITE function returns a comma-delimited list of compartments to which the user is authorized to write.
- [SA_SESSION.GROUP_READ](#)
The SA_SESSION.GROUP_READ function returns a comma-delimited list of groups that the user is authorized to read.
- [SA_SESSION.GROUP_WRITE](#)
The SA_SESSION.GROUP_WRITE function returns a comma-delimited list of groups that the user is authorized to write.
- [SA_SESSION.LABEL](#)
The SA_SESSION.LABEL function returns the label that is associated with the specified policy for the current session.
- [SA_SESSION.MAX_LEVEL](#)
The SA_SESSION.MAX_LEVEL function returns the maximum Oracle Label Security level authorized for the session.

- [SA_SESSION.MAX_READ_LABEL](#)
The `SA_SESSION.MAX_READ_LABEL` function returns the label string that was used to initialize the user's maximum authorized read label.
- [SA_SESSION.MAX_WRITE_LABEL](#)
The `SA_SESSION.MAX_WRITE_LABEL` function returns the label string that was used to initialize the user's maximum authorized write label.
- [SA_SESSION.MIN_LEVEL](#)
The `SA_SESSION.MIN_LEVEL` function returns the minimum Oracle Label Security level authorized for the session.
- [SA_SESSION.MIN_WRITE_LABEL](#)
The `SA_SESSION.MIN_WRITE_LABEL` function retrieves the label string that was used to initialize the user's minimum authorized write label.
- [SA_SESSION.PRIVS](#)
The `SA_SESSION.PRIVS` function returns the set of current session privileges, in a comma-delimited list.
- [SA_SESSION.RESTORE_DEFAULT_LABELS](#)
The `SA_SESSION.RESTORE_DEFAULT_LABELS` procedure restores the session label and row label to those stored in the data dictionary.
- [SA_SESSION.ROW_LABEL](#)
The `SA_SESSION.ROW_LABEL` function returns the name of the row label that is associated with the policy for the current session.
- [SA_SESSION.SET_LABEL](#)
The `SA_SESSION.SET_LABEL` procedure sets the label of the current database session.
- [SA_SESSION.SA_USER_NAME](#)
The `SA_SESSION.SA_USER_NAME` function returns the name of the current Oracle Label Security user, as set by the `SA_SESSION.SET_ACCESS_PROFILE` procedure (or as established at login).
- [SA_SESSION.SAVE_DEFAULT_LABELS](#)
The `SA_SESSION.SAVE_DEFAULT_LABELS` procedure stores the current session label and row label as your initial session label and default row label.
- [SA_SESSION.SET_ACCESS_PROFILE](#)
The `SA_SESSION.SET_ACCESS_PROFILE` procedure sets the Oracle Label Security authorizations and privileges of the database session to those of the specified user.
- [SA_SESSION.SET_ROW_LABEL](#)
The `SA_SESSION.SET_ROW_LABEL` procedure sets the default row label value for the current database session.

D.5.1 About the SA_SESSION PL/SQL Package

The `SA_SESSION` PL/SQL package manages user name, levels, labels, and read and write permissions for a user session.

Users can change labels during a session within the authorizations set by the administrator.

You do not need special privileges to use this package.

**See Also:**

[SA_UTL PL/SQL Utility Functions and Procedures](#) for additional functions that return numeric label tags and `BOOLEAN` values

D.5.2 SA_SESSION.COMP_READ

The `SA_SESSION.COMP_READ` function returns a comma-delimited list of compartments that the user is authorized to read.

Syntax

```
SA_SESSION.COMP_READ (
  policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-28 SA_SESSION.COMP_READ Parameter

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example returns the compartments that the user can read for the `hr_ols_pol` policy.

```
SELECT SA_SESSION.COMP_READ ('hr_ols_pol') FROM DUAL;
```

D.5.3 SA_SESSION.COMP_WRITE

The `SA_SESSION.COMP_WRITE` function returns a comma-delimited list of compartments to which the user is authorized to write.

This function is a subset of `SA_SESSION.COMP_READ`.

Syntax

```
SA_SESSION.COMP_WRITE (
  policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-29 SA_SESSION.COMP_WRITE Parameter

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example returns the compartments that the user can modify for the `hr_ols_pol` policy.

```
SELECT SA_SESSION.COMP_WRITE ('hr_ols_pol') FROM DUAL;
```

D.5.4 SA_SESSION.GROUP_READ

The `SA_SESSION.GROUP_READ` function returns a comma-delimited list of groups that the user is authorized to read.

Syntax

```
SA_SESSION.GROUP_READ (  
    policy_name IN VARCHAR2)  
RETURN VARCHAR2;
```

Parameter

Table D-30 SA_SESSION.GROUP_READ Parameter

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example returns the list of groups that a user can read for the `hr_ols_pol` policy.

```
SELECT SA_SESSION.GROUP_READ ('hr_ols_pol') FROM DUAL;
```

D.5.5 SA_SESSION.GROUP_WRITE

The `SA_SESSION.GROUP_WRITE` function returns a comma-delimited list of groups that the user is authorized to write.

This function is a subset of `SA_SESSION.GROUP_READ`.

Syntax

```
SA_SESSION.GROUP_WRITE (  
    policy_name IN VARCHAR2)  
RETURN VARCHAR2;
```

Parameter

Table D-31 SA_SESSION.GROUP_WRITE Parameter

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example returns the groups the user is authorized to modify for the `hr_ols_pol` policy.

```
SELECT SA_SESSION.GROUP_WRITE ('hr_ols_pol') FROM DUAL;
```

D.5.6 SA_SESSION.LABEL

The `SA_SESSION.LABEL` function returns the label that is associated with the specified policy for the current session.

Syntax

```
SA_SESSION.LABEL (
  policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter**Table D-32 SA_SESSION.LABEL Parameter**

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example returns the label that is associated with the `hr_ols_pol` policy.

```
SELECT SA_SESSION.LABEL ('hr_ols_pol') FROM DUAL;
```

D.5.7 SA_SESSION.MAX_LEVEL

The `SA_SESSION.MAX_LEVEL` function returns the maximum Oracle Label Security level authorized for the session.

Syntax

```
SA_SESSION.MAX_LEVEL (
  policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter**Table D-33 SA_SESSION.MAX_LEVEL Parameter**

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example returns the maximum Oracle Label Security level that is authorized for the `hr_ols_pol` policy.

```
SELECT SA_SESSION.MAX_LEVEL ('hr_ols_pol') FROM DUAL;
```

D.5.8 SA_SESSION.MAX_READ_LABEL

The `SA_SESSION.MAX_READ_LABEL` function returns the label string that was used to initialize the user's maximum authorized read label.

The return string is composed of the user's maximum level, compartments authorized for read access, and groups authorized for read access.

Syntax

```
SA_SESSION.MAX_READ_LABEL (
    policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-34 SA_SESSION.MAX_READ_LABEL Parameter

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Example

The following example returns the maximum read label privileges for the `hr_ols_pol` policy.

```
SELECT SA_SESSION.MAX_READ_LABEL ('hr_ols_pol') FROM DUAL;
```

D.5.9 SA_SESSION.MAX_WRITE_LABEL

The `SA_SESSION.MAX_WRITE_LABEL` function returns the label string that was used to initialize the user's maximum authorized write label.

This return string is composed of the user's maximum level, compartments authorized for write access, and groups authorized for write access.

Syntax

```
SA_SESSION.MAX_WRITE_LABEL (
    policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-35 SA_SESSION.MAX_WRITE_LABEL Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example returns the maximum write label privileges for the hr_ols_pol policy.

```
SELECT SA_SESSION.MAX_WRITE_LABEL ('hr_ols_pol') FROM DUAL;
```

D.5.10 SA_SESSION.MIN_LEVEL

The SA_SESSION.MIN_LEVEL function returns the minimum Oracle Label Security level authorized for the session.

Syntax

```
SA_SESSION.MIN_LEVEL (
    policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-36 SA_SESSION.MIN_LEVEL Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example returns the current minimum level for the hr_ols_pol policy.

```
SELECT SA_SESSION.MIN_LEVEL ('hr_ols_pol') FROM DUAL;
```

D.5.11 SA_SESSION.MIN_WRITE_LABEL

The SA_SESSION.MIN_WRITE_LABEL function retrieves the label string that was used to initialize the user's minimum authorized write label.

The return string contains only the level, with no compartments or groups.

Syntax

```
SA_SESSION.MIN_WRITE_LABEL (
    policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-37 SA_SESSION.MIN_WRITE_LABEL Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example returns the maximum write label privileges for the hr_ols_pol policy.

```
SELECT SA_SESSION.MIN_WRITE_LABEL ('hr_ols_pol') FROM DUAL;
```

D.5.12 SA_SESSION.PRIVS

The SA_SESSION.PRIVS function returns the set of current session privileges, in a comma-delimited list.

Syntax

```
SA_SESSION.PRIVS (
    policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-38 SA_SESSION.Privs Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example returns the current session privileges for the hr_ols_pol policy.

```
SELECT SA_SESSION.PRIVS ('hr_ols_pol') FROM DUAL;
```

D.5.13 SA_SESSION.RESTORE_DEFAULT_LABELS

The SA_SESSION.RESTORE_DEFAULT_LABELS procedure restores the session label and row label to those stored in the data dictionary.

This command is useful to reset values after a SA_SESSION.SET_LABEL command has been processed.

Syntax

```
SA_SESSION.RESTORE_DEFAULT_LABELS (
    policy_name in VARCHAR2);
```

Parameter

Table D-39 SA_SESSION.RESTORE_DEFAULT_LABEL Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example restores the default labels for the hr_ols_pol policy.

```
BEGIN
  SA_SESSION.RESTORE_DEFAULT_LABELS (
    policy_name      => 'hr_ols_pol');
END;
/
```

D.5.14 SA_SESSION.ROW_LABEL

The SA_SESSION.ROW_LABEL function returns the name of the row label that is associated with the policy for the current session.

Syntax

```
SA_SESSION.ROW_LABEL (
  policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-40 SA_SESSION.ROW_LABEL Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example returns the row label that is associated with the hr_ols_pol policy.

```
SELECT SA_SESSION.ROW_LABEL ('hr_ols_pol') FROM DUAL;
```

D.5.15 SA_SESSION.SET_LABEL

The SA_SESSION.SET_LABEL procedure sets the label of the current database session.

You can set the session label to:

- Any level equal to or less than the maximum, and equal to or greater than the minimum level
- Include any compartments in the authorized compartment list
- Include any groups in the authorized group list. (Subgroups of authorized groups are implicitly included in the authorized list.)

Note that if you change the session label, this change may affect the value of the session's row label. The session's row label contains the subset of compartments and groups for which the user has write access. This may or may not be equivalent to the session label. For example, if you use the `SA_SESSION.SET_LABEL` procedure to set your current session label to `C:A,B:US` and you have write access only on the `A` compartment, then your row label would be set to `C:A`.

Syntax

```
SA_SESSION.SET_LABEL (
  policy_name IN VARCHAR2,
  label       IN VARCHAR2);
```

Parameters

Table D-41 SA_SESSION.SET_LABEL Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>label</code>	The value to set as the label

Example

The following example sets the label for the `hr_ols_pol` policy.

```
BEGIN
  SA_SESSION.SET_LABEL (
    policy_name => 'hr_ols_pol',
    label       => 'C:A,B:US');
END;
/
```

Related Topics

- [SA_USER_ADMIN.SET_DEFAULT_LABEL](#)
The `SA_USER_ADMIN.SET_DEFAULT_LABEL` procedure sets the user's initial session label to the one specified.

D.5.16 SA_SESSION.SA_USER_NAME

The `SA_SESSION.SA_USER_NAME` function returns the name of the current Oracle Label Security user, as set by the `SA_SESSION.SET_ACCESS_PROFILE` procedure (or as established at login).

This is how you can determine the identity of the current user in relation to Oracle Label Security, rather than in relation to your Oracle login name.

Syntax

```
SA_SESSION.SA_USER_NAME (
  policy_name IN VARCHAR2)
RETURN VARCHAR2;
```

Parameter

Table D-42 SA_SESSION.SA_USER_NAME Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example finds the name of the Oracle Label Security user for the hr_ols_pol policy.

```
SELECT SA_SESSION.SA_USER_NAME ('hr_ols_pol') FROM DUAL;
```

D.5.17 SA_SESSION.SAVE_DEFAULT_LABELS

The SA_SESSION.SAVE_DEFAULT_LABELS procedure stores the current session label and row label as your initial session label and default row label.

This procedure permits you to change your defaults to reflect your current session label and row label. The saved labels will be used as the initial default settings for future sessions.

When you log in to a database, your default session label and row label are used to initialize the session label and row label. When the administrator originally authorized your Oracle Label Security labels, they also defined your default level, default compartments, and default groups. If you change your session label and row label, and want to save these values as the default labels, you can use the SA_SESSION.SAVE_DEFAULT_LABELS procedure.

This procedure is useful if you have multiple sessions and want to be sure that all additional sessions have the same labels. You can save the current labels as the default, and all future sessions will have these as the initial labels.

Consider a situation in which you connect to the database through Oracle Forms and want to run a report. By saving the current session labels as the default before you call Oracle Reports, you ensure that Oracle Reports will initialize at the same labels as are being used by Oracle Forms.

Syntax

```
SA_SESSION.SAVE_DEFAULT_LABELS (
    policy_name IN VARCHAR2);
```

Parameter

Table D-43 SA_SESSION.SAVE_DEFAULT_LABELS Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example saves the label defaults for the hr_ols_pol policy.

```
BEGIN
  SA_SESSION.SAVE_DEFAULT_LABELS (
    policy_name      => 'hr_ols_pol');
END;
/
```



Note:

The SA_SESSION.SAVE_DEFAULT_LABELS procedure overrides the settings established by the administrator.

D.5.18 SA_SESSION.SET_ACCESS_PROFILE

The SA_SESSION.SET_ACCESS_PROFILE procedure sets the Oracle Label Security authorizations and privileges of the database session to those of the specified user.

Note that the originating user retains the PROFILE_ACCESS privilege.

The user who runs the SA_SESSION.SET_ACCESS_PROFILE procedure must have the PROFILE_ACCESS privilege. The logged-in database user (the Oracle user ID) does not change. That user assumes only the authorizations and privileges of the specified user. By contrast, the Oracle Label Security user name *is* changed.

This administrative procedure is useful for various tasks:

- With SA_SESSION.SET_ACCESS_PROFILE, you can see the result of the authorization and privilege settings for a particular user.
- Applications need to have proxy accounts connect as (and assume the identity of) application users, for purposes of accessing labeled data. With the SA_SESSION.SET_ACCESS_PROFILE privilege, the proxy account can act on behalf of the application users.

Syntax

```
SA_SESSION.SET_ACCESS_PROFILE (
  policy_name IN VARCHAR2
  user_name   IN VARCHAR2);
```

Parameters

Table D-44 SA_SESSION.SET_ACCESS_PROFILE Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Name of the user whose authorizations and privileges should be assumed (typically, the user associated with this policy). To find this user, query the USER_NAME and POLICY_NAME columns of the DBA_SA_USERS view.

Example

The following example enables user `psmith` to have Oracle Label Security authorizations and privileges for the database session.

```
BEGIN
  SA_SESSION.SET_ACCESS_PROFILE (
    policy_name      => 'hr_ols_pol',
    user_name       => 'jjones');
END;
/
```

D.5.19 SA_SESSION.SET_ROW_LABEL

The `SA_SESSION.SET_ROW_LABEL` procedure sets the default row label value for the current database session.

The compartments and groups in the label must be a subset of the compartments and groups in the session label to which the user has write access. When the `LABEL_DEFAULT` option is set, this row label value is used on insert if the user does not explicitly specify the label.

If the `SA_SESSION.SET_ROW_LABEL` procedure is not used to set the default row label value, then this value is automatically derived from the session label. It contains the level of the session label and the subset of the compartments and groups in the session label for which the user has write authorization.

The row label is automatically reset if the session label changes. For example, if you change your session level from `HIGHLY_SENSITIVE` to `SENSITIVE`, then the level component of the row label automatically changes to `SENSITIVE`.

The user can set the row label independently, but only to include:

- A level that is less than or equal to the level of the session label, and greater than or equal to the user's minimum level
- A subset of the compartments and groups from the session label, for which the user is authorized to have write access

If the user tries to set the row label to an invalid value, then the operation is not permitted and the row label value is unchanged.

Syntax

```
SA_SESSION.SET_ROW_LABEL (
  policy_name  IN VARCHAR2,
  row_label    IN VARCHAR2);
```

Parameters

Table D-45 SA_SESSION.SET_ROW_LABEL Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>label</code>	The value to set as the default row label

Example

The following example sets the row label for the `hr_ols_pol` policy.

```
BEGIN
  SA_SESSION.SET_ROW_LABEL (
    policy_name => 'hr_ols_pol',
    label       => 'HR');
END;
/
```

Related Topics

- [SA_USER_ADMIN.SET_ROW_LABEL](#)
The `SA_USER_ADMIN.SET_ROW_LABEL` procedure sets a user's initial row label to the one specified.

D.6 SA_SYSDBA Policy Management PL/SQL Package

The `SA_SYSDBA` PL/SQL package manages Oracle Label Security policies.

- [About the SA_SYSDBA PL/SQL Package](#)
The `SA_SYSDBA` PL/SQL package creates, modifies, enables or disables, and drops Oracle Label Security policies.
- [SA_SYSDBA.ALTER_POLICY](#)
The `SA_SYSDBA.ALTER_POLICY` procedure sets and modifies column names that are associated with the policy.
- [SA_SYSDBA.CREATE_POLICY](#)
The `SA_SYSDBA.CREATE_POLICY` procedure creates a new Oracle Label Security policy, defines a policy-specific column name, and specifies default policy options.
- [SA_SYSDBA.DISABLE_POLICY](#)
The `SA_SYSDBA.DISABLE_POLICY` procedure turns off enforcement of a policy, without removing it from the database.
- [SA_SYSDBA.DROP_POLICY](#)
The `SA_SYSDBA.DROP_POLICY` procedure deletes the policy and its associated user labels and data labels from the database.
- [SA_SYSDBA.ENABLE_POLICY](#)
The `SA_SYSDBA.ENABLE_POLICY` procedure enforces access control on the tables and schemas protected by the policy.

D.6.1 About the SA_SYSDBA PL/SQL Package

The `SA_SYSDBA` PL/SQL package creates, modifies, enables or disables, and drops Oracle Label Security policies.

To use this package, you must be granted the `LBAC_DBA` role and the `EXECUTE` privilege on the `SA_SYSDBA` package. The `SA_SYSDBA` package is an invoker's rights package, so you must provide the following `INHERIT PRIVILEGES` grant to the user `SYS` before you can use this package:

```
GRANT INHERIT PRIVILEGES ON USER SYS TO LBACSYS;
```

You only need to grant this privilege on user `SYS`. You do not need to grant it on other users.

D.6.2 SA_SYSDBA.ALTER_POLICY

The `SA_SYSDBA.ALTER_POLICY` procedure sets and modifies column names that are associated with the policy.

`SA_SYSDBA.ALTER_POLICY` can only be used to change column name for policies that are not applied on any user tables or schemas. Otherwise, this error appears:

```
12474, 00000, "cannot change column name for a policy in use"
```

Syntax

```
SA_SYSDBA.ALTER_POLICY (  
    policy_name      IN  VARCHAR2,  
    default_options  IN  VARCHAR2 DEFAULT NULL,  
    column_name      IN  VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-46 SA_SYSDBA.ALTER_POLICY Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>default_options</code>	Specifies the default enforcement options to be used when the policy is applied and no table- or schema-specific options are specified. Includes enforcement options and the option to hide the label column. Separate each option with a comma. See Categories of Policy Enforcement Options for a listing of the default enforcement options.
<code>column_name</code>	Specifies the column name associated with the policy. To find this column name, query the <code>COLUMN_NAME</code> column of the <code>ALL_SA_POLICIES</code> view.

Example

The following example updates the `hr_ols_pol` policy to use a different set of default options. Because the name of the column does not need to change, the `column_name` parameter is omitted.

```
BEGIN  
  SA_SYSDBA.ALTER_POLICY (  
    policy_name      => 'hr_ols_pol',  
    default_options  => 'read_control, delete_control');  
END;  
/
```

D.6.3 SA_SYSDBA.CREATE_POLICY

The `SA_SYSDBA.CREATE_POLICY` procedure creates a new Oracle Label Security policy, defines a policy-specific column name, and specifies default policy options.

After you create the policy, a role for it is created and granted to you. The format of the role name is `policy_DBA` (for example, `my_ols_pol_DBA`).

Syntax

```
SA_SYSDBA.CREATE_POLICY (
    policy_name      IN VARCHAR2,
    column_name      IN VARCHAR2 DEFAULT NULL,
    default_options  IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-47 SA_SYSDBA.CREATE_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy name, which must be unique within the database. It can have a maximum of 30 characters, but only the first 26 characters in the <code>policy_name</code> are significant. Two policies may not have the same first 26 characters in the <code>policy_name</code> . To find a list of existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
column_name	Specifies the name of the column to be added to tables protected by the policy. If <code>NULL</code> , then the name <code>policy_name_COL</code> is used. Two Oracle Label Security policies cannot share the same column name.
default_options	Specifies the default options to be used when the policy is applied and no table- or schema-specific options are specified. Includes enforcement options and the option to hide the label column. Separate each option with a comma. See Categories of Policy Enforcement Options for a listing of the default enforcement options.

Example

The following example creates a policy container whose default options are `READ_CONTROL` and `WRITE_CONTROL`. The `WRITE_CONTROL` option encompasses the `INSERT_CONTROL`, `UPDATE_CONTROL`, and `DELETE_CONTROL` options.

```
BEGIN
  SA_SYSDBA.CREATE_POLICY (
    policy_name      => 'hr_ols_pol',
    column_name      => 'ols_col',
    default_options  => 'read_control, write_control');
END;
/
```

D.6.4 SA_SYSDBA.DISABLE_POLICY

The `SA_SYSDBA.DISABLE_POLICY` procedure turns off enforcement of a policy, without removing it from the database.

The policy is not enforced for all subsequent access to the database.

To disable a policy means that no access control is enforced on the tables and schemas protected by the policy. The administrator can continue to perform administrative operations while the policy is disabled.

 **Note:**

This feature is extremely powerful, and should be used with caution. When a policy is disabled, anyone who connects to the database can access all the data normally protected by the policy. So, your site should establish guidelines for use of this feature.

Normally, a policy should not be disabled in order to manage data. At times, however, an administrator may need to disable a policy to perform application debugging tasks. In this case, the database should be run in single-user mode. In a development environment, for example, you may need to observe data processing operations without the policy turned on. When you reenables the policy, all of the selected enforcement options become effective again.

Syntax

```
SA_SYSDBA.DISABLE_POLICY (
  policy_name IN VARCHAR2);
```

Parameters**Table D-48 SA_SYSDBA.DISABLE_POLICY Parameters**

Parameter	Description
policy_name	Specifies the policy. To find existing policies and their status, query the POLICY_NAME and STATUS columns of the ALL_SA_POLICIES data dictionary view.

Example

The following example disables the hr_ols_pol policy:

```
EXEC SA_SYSDBA.DISABLE_POLICY ('hr_ols_pol');
```

D.6.5 SA_SYSDBA.DROP_POLICY

The SA_SYSDBA.DROP_POLICY procedure deletes the policy and its associated user labels and data labels from the database.

This procedure purges the policy and these associations from the system entirely. You can optionally drop the label column from all tables controlled by the policy. The policy does not need to be disabled before you drop it.

Syntax

```
SA_SYSDBA.DROP_POLICY (
  policy_name IN VARCHAR2,
  drop_column BOOLEAN DEFAULT FALSE);
```

Parameters

Table D-49 SA_SYSDBA.DROP_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy to be dropped. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
drop_column	Indicates that the policy column should be dropped from protected tables (TRUE)

Example

The following example deletes the hr_ols_pol policy.

```
EXEC SA_SYSDBA.DROP_POLICY ('hr_ols_pol');
```

D.6.6 SA_SYSDBA.ENABLE_POLICY

The SA_SYSDBA.ENABLE_POLICY procedure enforces access control on the tables and schemas protected by the policy.

A policy is automatically enabled when it is created. After creation or enablement, the policy is enforced for all subsequent access to tables protected by the policy.

Syntax

```
SA_SYSDBA.ENABLE_POLICY (policy_name IN VARCHAR2);
```

Parameters

Table D-50 SA_SYSDBA.ENABLE_POLICY Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies and their status, query the POLICY_NAME and STATUS columns of the ALL_SA_POLICIES data dictionary view.

Example

The following example enables the hr_ols_pol policy.

```
EXEC SA_SYSDBA.ENABLE_POLICY('hr_ols_pol');
```

D.7 SA_USER_ADMIN PL/SQL Package

The SA_USER_ADMIN PL/SQL package manages user labels by label component.

- [About the SA_USER_ADMIN PL/SQL Package](#)
The SA_USER_ADMIN PL/SQL package configures compartments, groups, user access, labels, levels, and privileges.

- **SA_USER_ADMIN.ADD_COMPARTMENTS**
The SA_USER_ADMIN.ADD_COMPARTMENTS procedure adds (assigns) compartments to a user's authorizations, indicating if the compartments are authorized for write and read privileges.
- **SA_USER_ADMIN.ADD_GROUPS**
The SA_USER_ADMIN.ADD_GROUPS procedure adds (assigns) groups to a user, indicating if the groups are authorized for write and read privileges.
- **SA_USER_ADMIN.ALTER_COMPARTMENTS**
The SA_USER_ADMIN.ALTER_COMPARTMENTS procedure changes the write access, default label indicator, and row label indicator for the specified compartments.
- **SA_USER_ADMIN.ALTER_GROUPS**
The SA_USER_ADMIN.ALTER_GROUPS procedure changes the write access, default label indicator, and row label indicator for the specified groups.
- **SA_USER_ADMIN.DROP_ALL_COMPARTMENTS**
The SA_USER_ADMIN.DROP_ALL_COMPARTMENTS procedure drops all compartments from a user's authorizations.
- **SA_USER_ADMIN.DROP_ALL_GROUPS**
The SA_USER_ADMIN.DROP_ALL_GROUPS procedure drops all groups from a user's authorizations.
- **SA_USER_ADMIN.DROP_COMPARTMENTS**
The SA_USER_ADMIN.DROP_COMPARTMENTS procedure drops the specified compartments from a user's authorizations.
- **SA_USER_ADMIN.DROP_GROUPS**
The SA_USER_ADMIN.DROP_GROUPS procedure drops the specified groups from a user's authorizations.
- **SA_USER_ADMIN.DROP_USER_ACCESS**
The SA_USER_ADMIN.DROP_USER_ACCESS procedure removes all Oracle Label Security authorizations and privileges from the specified user.
- **SA_USER_ADMIN.SET_COMPARTMENTS**
The SA_USER_ADMIN.SET_COMPARTMENTS procedure assigns compartments to a user and identifies default values for the user's session label and row label.
- **SA_USER_ADMIN.SET_DEFAULT_LABEL**
The SA_USER_ADMIN.SET_DEFAULT_LABEL procedure sets the user's initial session label to the one specified.
- **SA_USER_ADMIN.SET_GROUPS**
The SA_USER_ADMIN.SET_GROUPS procedure assigns groups to a user and identifies default values for the user's session label and row label.
- **SA_USER_ADMIN.SET_LEVELS**
The SA_USER_ADMIN.SET_LEVELS procedure assigns a user minimum and maximum levels and identifies default values for the user's session label and row label.
- **SA_USER_ADMIN.SET_PROG_PRIVS**
The SA_USER_ADMIN.SET_PROG_PRIVS procedure sets policy-specific privileges for program units.
- **SA_USER_ADMIN.SET_ROW_LABEL**
The SA_USER_ADMIN.SET_ROW_LABEL procedure sets a user's initial row label to the one specified.

- [SA_USER_ADMIN.SET_USER_LABELS](#)
The `SA_USER_ADMIN.SET_USER_LABELS` procedure sets the user's levels, compartments, and groups using a set of labels, instead of the individual components.
- [SA_USER_ADMIN.SET_USER_PRIVS](#)
The `SA_USER_ADMIN.SET_USER_PRIVS` procedure sets policy-specific privileges for users.

D.7.1 About the SA_USER_ADMIN PL/SQL Package

The `SA_USER_ADMIN` PL/SQL package configures compartments, groups, user access, labels, levels, and privileges.

To use this package, you must be granted the `policy_DBA` role (for example, `HR_OLS_POL_DBA` for a role for the `hr_ols_pol` policy) and the `EXECUTE` privilege on the `SA_USER_ADMIN` package.

D.7.2 SA_USER_ADMIN.ADD_COMPARTMENTS

The `SA_USER_ADMIN.ADD_COMPARTMENTS` procedure adds (assigns) compartments to a user's authorizations, indicating if the compartments are authorized for write and read privileges.

This procedure is useful if you have already used the `SA_USER_ADMIN.SET_COMPARTMENTS` procedure for the user but then decide that you want to grant this user authorization for additional compartments, or to update the current set of compartments. You also can use it in place of `SA_USER_ADMIN.SET_COMPARTMENTS`.

Syntax

```
SA_USER_ADMIN.ADD_COMPARTMENTS (
policy_name      IN VARCHAR2,
user_name       IN VARCHAR2,
comps           IN VARCHAR2,
access_mode     IN VARCHAR2 DEFAULT NULL,
in_def         IN VARCHAR2 DEFAULT NULL,
in_row         IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-51 SA_USER_ADMIN.ADD_COMPARTMENTS Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>user_name</code>	Specifies the user name. This user can be either a new user or a user who has already been authorized for this policy's compartments. To find an existing user, query the <code>USER_NAME</code> column of the <code>DBA_SA_USER_COMPARTMENTS</code> view.
<code>comps</code>	A comma-delimited list of compartments to add, by short name only. To find existing compartments, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_COMPARTMENTS</code> view.
<code>access_mode</code>	One of two public variables that contain string values that can specify the type of access authorized. The variable names, values, and meaning are as follows: <ul style="list-style-type: none"> • <code>SA_UTL.READ_ONLY</code> indicates no write access • <code>SA_UTL.READ_WRITE</code> indicates that write is authorized • If <code>access_mode</code> is <code>NULL</code>, then it is set to <code>SA_UTL.READ_ONLY</code>.

Table D-51 (Cont.) SA_USER_ADMIN.ADD_COMPARTMENTS Parameters

Parameter	Description
in_def	Specifies whether these compartments should be in the default compartments (Y/N) If in_def is NULL, then it is set to Y.
in_row	Specifies whether these compartments should be in the row label (Y/N) If in_row is NULL, then it is set to N.

Example

The following example adds compartments to the hr_ols_pol policy.

```
BEGIN
  SA_USER_ADMIN.ADD_COMPARTMENTS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    comps      => 'FIN',
    access_mode => SA_UTL.READ_ONLY,
    in_def     => 'y',
    in_row     => 'y');
END;
/
```

D.7.3 SA_USER_ADMIN.ADD_GROUPS

The SA_USER_ADMIN.ADD_GROUPS procedure adds (assigns) groups to a user, indicating if the groups are authorized for write and read privileges.

This procedure is useful if you have already used the SA_USER_ADMIN.SET_GROUPS procedure for the user but then decide that you want to grant this user authorization for additional groups or to update the current set of groups. You also can use it in place of SA_USER_ADMIN.SET_GROUPS.

Syntax

```
SA_USER_ADMIN.ADD_GROUPS (
  policy_name      IN VARCHAR2,
  user_name        IN VARCHAR2,
  groups           IN VARCHAR2,
  access_mode      IN VARCHAR2 DEFAULT NULL,
  in_def           IN VARCHAR2 DEFAULT NULL,
  in_row           IN VARCHAR2 DEFAULT NULL);
```

Parameters**Table D-52 SA_USER_ADMIN.ADD_GROUPS Parameters**

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user. This user can be either a new user or a user who has already been authorized for this policy's groups. To find an existing user, query the USER_NAME column of the DBA_SA_USER_GROUPS view.

Table D-52 (Cont.) SA_USER_ADMIN.ADD_GROUPS Parameters

Parameter	Description
groups	A comma-delimited list of groups to add, by short name only. To find a list of existing groups, query the SHORT_NAME column of the ALL_SA_GROUPS view.
access_mode	One of two public variables that contain string values that can specify the type of access authorized. The variable names, values, and meaning are as follows: <ul style="list-style-type: none"> SA_UTL.READ_ONLY indicates no write access SA_UTL.READ_WRITE indicates that write is authorized If access_mode is NULL, then access_mode is set to SA_UTL.READ_ONLY.
in_def	Specifies whether these groups should be in the default groups (Y/N) If in_def is NULL, then it is set to Y.
in_row	Specifies whether these groups should be in the row label (Y/N) If in_row is NULL, then it is set to N.

Example

The following example adds several groups to the hr_ols_pol policy.

```
BEGIN
  SA_USER_ADMIN.ADD_GROUPS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    groups      => 'ER_FIN, SR_FIN, NR_FIN, WR_FIN',
    access_mode => SA_UTL.READ_WRITE,
    in_def      => 'y',
    in_row      => 'y');
END;
/
```

D.7.4 SA_USER_ADMIN.ALTER_COMPARTMENTS

The SA_USER_ADMIN.ALTER_COMPARTMENTS procedure changes the write access, default label indicator, and row label indicator for the specified compartments.

Syntax

```
SA_USER_ADMIN.ALTER_COMPARTMENTS (
  policy_name IN VARCHAR2,
  user_name   IN VARCHAR2,
  comps       IN VARCHAR2,
  access_mode IN VARCHAR2 DEFAULT NULL,
  in_def      IN VARCHAR2 DEFAULT NULL,
  in_row      IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-53 SA_USER_ADMIN.ALTER_COMPARTMENTS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user who has been authorized for the compartment. To find authorized users, query the USER_NAME column of the DBA_SA_USER_COMPARTMENTS view.
comps	A comma-delimited list of compartments to modify, using the short name only. To find existing compartments, query the SHORT_NAME column of the ALL_SA_COMPARTMENTS view.
access_mode	One of two public variables that contain string values that can specify the type of access authorized. The variable names, values, and meaning are as follows: SA_UTL.READ_ONLY indicates no write access SA_UTL.READ_WRITE indicates that write is authorized If access_mode is NULL, then access_mode for the compartment is unaltered.
in_def	Specifies whether these compartments should be in the default compartments (Y/N) If in_def is NULL, then in_def for the compartment is unaltered.
in_row	Specifies whether these compartments should be in the row label (Y/N) If in_row is NULL, then in_row for the compartment is unaltered. If in_def is N, then in_row cannot be Y. This is because the row label compartments must be a subset of the session label compartments.

Example

The following example modifies compartments for the hr_ols_pol policy.

```
BEGIN
  SA_USER_ADMIN.ALTER_COMPARTMENTS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    comps       => 'FIN',
    access_mode => SA_UTL.READ_ONLY,
    in_def      => 'y',
    in_row      => 'y');
END;
/
```

D.7.5 SA_USER_ADMIN.ALTER_GROUPS

The SA_USER_ADMIN.ALTER_GROUPS procedure changes the write access, default label indicator, and row label indicator for the specified groups.

Syntax

```
SA_USER_ADMIN.ALTER_GROUPS (
  policy_name IN VARCHAR2,
  user_name   IN VARCHAR2,
```

```

groups          IN VARCHAR2,
access_mode     IN VARCHAR2 DEFAULT NULL,
in_def          IN VARCHAR2 DEFAULT NULL,
in_row          IN VARCHAR2 DEFAULT NULL);

```

Parameters

Table D-54 SA_USER_ADMIN.ALTER_GROUPS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user who has been authorized for the group. To find existing users, query the USER_NAME and GRP columns of the DBA_SA_USER_GROUPS view.
groups	A comma-delimited list of groups to alter, by short name only. To find existing groups, query the SHORT_NAME column of the ALL_SA_GROUPS view.
access_mode	Two public variables contain string values that can specify the type of access authorized. The variable names, values, and meaning are as follows: SA_UTL.READ_ONLY indicates no write access SA_UTL.READ_WRITE indicates that write is authorized If access_mode is NULL, then access_mode for the group is unaltered.
in_def	Specifies whether these groups should be in the default groups (Y/N) If in_def is NULL, then in_def for the group is unaltered.
in_row	Specifies whether these groups should be in the row label ((Y/N) If in_row is NULL, then in_row for the group is unaltered. If in_def is N, then in_row cannot be Y. This is because the row label groups must be a subset of the session label groups.

Example

The following example sets the access mode for the existing groups to be read only.

```

BEGIN
  SA_USER_ADMIN.ALTER_GROUPS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    groups      => 'ER',
    access_mode => SA_UTL.READ_ONLY);
END;
/

```

D.7.6 SA_USER_ADMIN.DROP_ALL_COMPARTMENTS

The SA_USER_ADMIN.DROP_ALL_COMPARTMENTS procedure drops all compartments from a user's authorizations.

Syntax

```

SA_USER_ADMIN.DROP_ALL_COMPARTMENTS (
  policy_name IN VARCHAR2,
  user_name   IN VARCHAR2);

```

Parameters

Table D-55 SA_USER_ADMIN.DROP_ALL_COMPARTMENTS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user who has been authorized for the compartment. To find existing users, query the USER_NAME column of the DBA_SA_USER_COMPARTMENTS view.

Example

The following example drops all compartments for the hr_ols_pol policy for user jjones.

```
BEGIN
  SA_USER_ADMIN.DROP_ALL_COMPARTMENTS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones');
END;
/
```

D.7.7 SA_USER_ADMIN.DROP_ALL_GROUPS

The SA_USER_ADMIN.DROP_ALL_GROUPS procedure drops all groups from a user's authorizations.

Syntax

```
SA_USER_ADMIN.DROP_ALL_GROUPS (
  policy_name IN VARCHAR2,
  user_name   IN VARCHAR2);
```

Parameters

Table D-56 SA_USER_ADMIN.DROP_ALL_GROUPS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user who has been authorized for the group. To find existing users, query the USER_NAME and GRP columns of the DBA_SA_USER_GROUPS view.

Example

The following example drops all groups from the hr_ols_pol policy for user jjones.

```
BEGIN
  SA_USER_ADMIN.DROP_ALL_GROUPS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones');
END;
/
```

D.7.8 SA_USER_ADMIN.DROP_COMPARTMENTS

The `SA_USER_ADMIN.DROP_COMPARTMENTS` procedure drops the specified compartments from a user's authorizations.

Syntax

```
SA_USER_ADMIN.DROP_COMPARTMENTS (
  policy_name    IN VARCHAR2,
  user_name      IN VARCHAR2,
  comps          IN VARCHAR2);
```

Parameters

Table D-57 SA_USER_ADMIN.DROP_COMPARTMENTS Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>user_name</code>	Specifies the user who has been authorized for the compartment. To find existing users, query the <code>USER_NAME</code> column of the <code>DBA_SA_USER_COMPARTMENTS</code> view.
<code>comps</code>	A comma-delimited list of compartments to drop. To find all comps for this policy, query the <code>POLICY_NAME</code> and <code>COMP</code> columns of the <code>DBA_SA_USER_COMPARTMENTS</code> view.

Example

The following example drops the `FINANCIAL` compartment from the `hr_ols_pol` policy.

```
BEGIN
  SA_USER_ADMIN.DROP_COMPARTMENTS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    comps       => 'HR');
END;
/
```

D.7.9 SA_USER_ADMIN.DROP_GROUPS

The `SA_USER_ADMIN.DROP_GROUPS` procedure drops the specified groups from a user's authorizations.

Syntax

```
SA_USER_ADMIN.DROP_GROUPS (
  policy_name IN VARCHAR2,
  user_name   IN VARCHAR2,
  groups      IN VARCHAR2);
```

Parameters

Table D-58 SA_USER_ADMIN.DROP_GROUPS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user who has been authorized for the group. To find existing users, query the USER_NAME and GRP columns of the DBA_SA_USER_GROUPS view.
groups	A comma-delimited list of groups to drop, by short name only. To find a list of groups, query the SHORT_NAME column of the ALL_SA_GROUPS view.

Example

The following example drops the NR_FIN group from the hr_ols_pol policy.

```
BEGIN
  SA_USER_ADMIN.DROP_GROUPS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    groups      => 'ER');
END;
/
```

D.7.10 SA_USER_ADMIN.DROP_USER_ACCESS

The SA_USER_ADMIN.DROP_USER_ACCESS procedure removes all Oracle Label Security authorizations and privileges from the specified user.

Syntax

```
SA_USER_ADMIN.DROP_USER_ACCESS (
  policy_name  IN VARCHAR2,
  user_name    IN VARCHAR2);
```

Parameters

Table D-59 SA_USER_ADMIN.DROP_USER_ACCESS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user name. To find all users associated with this policy, query the USER_NAME and POLICY_NAME columns of the DBA_SA_USER_PRIVS view.

Examples

The following example removes user jjones's authorization for the hr_ols_pol policy.

```
BEGIN
  SA_USER_ADMIN.DROP_USER_ACCESS (
```

```

    policy_name => 'hr_ols_pol',
    user_name   => 'jjones');
END;
/

```

D.7.11 SA_USER_ADMIN.SET_COMPARTMENTS

The `SA_USER_ADMIN.SET_COMPARTMENTS` procedure assigns compartments to a user and identifies default values for the user's session label and row label.

After you have set the compartment, you can configure additional compartments by using the `SA_USER_ADMIN.ADD_COMPARTMENTS` procedure. (See [SA_USER_ADMIN.ADD_COMPARTMENTS](#).)

All users must have their levels set before their authorized compartments can be established.

The write compartments, if specified, must be a subset of the read compartments. (The write compartments are those to which the user should have write access.)

Syntax

```

SA_USER_ADMIN.SET_COMPARTMENTS (
    policy_name  IN VARCHAR2,
    user_name    IN VARCHAR2,
    read_comps  IN VARCHAR2,
    write_comps IN VARCHAR2 DEFAULT NULL,
    def_comps   IN VARCHAR2 DEFAULT NULL,
    row_comps   IN VARCHAR2 DEFAULT NULL);

```

Parameters

Table D-60 SA_USER_ADMIN.SET_COMPARTMENTS Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>user_name</code>	Specifies the user name to assign compartments
<code>read_comps</code>	A comma-delimited list of compartments authorized for read access, by short name only To find all compartments, query the <code>SHORT_NAME</code> column of the <code>ALL_SA_COMPARTMENTS</code> view.
<code>write_comps</code>	A comma-delimited list of compartments authorized for write access (subset of <code>read_comps</code>), by short name only. If <code>write_comps</code> are <code>NULL</code> , then they are set to the <code>read_comps</code> .
<code>def_comps</code>	Specifies the default compartments, by short name only. This must be a subset of <code>read_comps</code> . If the <code>def_comps</code> are <code>NULL</code> , then they are set to the <code>read_comps</code> .
<code>row_comps</code>	Specifies the row compartments, by short name only. This must be a subset of <code>write_comps</code> and <code>def_comps</code> . If the <code>row_comps</code> are <code>NULL</code> , then they are set to the components in <code>def_comps</code> that are authorized for write access.

Example

The following example sets compartments for the `hr_ols_pol` policy.


```

BEGIN
  SA_USER_ADMIN.SET_COMPARTMENTS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    read_comps  => 'FIN',
    write_comps => 'FIN',
    def_comps   => 'FIN',
    row_comps   => 'FIN');
END;
/

```

D.7.12 SA_USER_ADMIN.SET_DEFAULT_LABEL

The `SA_USER_ADMIN.SET_DEFAULT_LABEL` procedure sets the user's initial session label to the one specified.

As long as the row label will still be dominated by the new write label, you can set the session label to:

- Any level equal to or less than their maximum, and equal to or greater than their minimum label
- Include any compartments in the authorized compartment list
- Include any groups in the authorized group list. (Subgroups of authorized groups are implicitly included in the authorized list.)

The row label must be dominated by the new write label that will result from resetting the session label. If this condition is not true, then the `SET_DEFAULT_LABEL` procedure will fail.

For example, suppose the current row label is `S:A,B`, and that you have write access to both compartments. If you attempt to set the new default label to `C:A,B`, then the `SET_LABEL` procedure will fail. This is because the new write label would be `C:A,B`, which does not dominate the current row label.

To successfully reset the session label in this case, you must first lower the row label to a value that will be dominated by the resulting session label.

Syntax

```

SA_USER_ADMIN.SET_DEFAULT_LABELS (
  policy_name IN VARCHAR2,
  user_name   IN VARCHAR2,
  def_label   IN VARCHAR2);

```

Parameters

Table D-61 SA_USER_ADMIN.SET_DEFAULT_LABEL Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>user_name</code>	Specifies the user who has been authorized with label components. To find this user, query the <code>USER_NAME</code> column of the <code>ALL_SA_USER_LABELS</code> view.

Table D-61 (Cont.) SA_USER_ADMIN.SET_DEFAULT_LABEL Parameters

Parameter	Description
def_label	Specifies the label string to be used to initialize the user's default labels. This label may contain any compartments and groups that are authorized for read access. To find existing labels, query the LABEL column of the ALL_SA_LABELS view.

Example

The following example sets the default label for hr_ols_pol for user jjones.

```
BEGIN
  SA_USER_ADMIN.SET_DEFAULT_LABEL (
    policy_name    => 'hr_ols_pol',
    user_name      => 'jjones',
    def_label      => 'HS');
END;
/
```

Related Topics

- [SA_SESSION Session Management PL/SQL Package](#)
The SA_SESSION PL/SQL package manages session behavior for user authorizations.

D.7.13 SA_USER_ADMIN.SET_GROUPS

The SA_USER_ADMIN.SET_GROUPS procedure assigns groups to a user and identifies default values for the user's session label and row label.

All users must have their levels set before their authorized groups can be established. You can find information about a user's level authorization by querying the DBA_SA_USER_LEVELS data dictionary view.

Syntax

```
SA_USER_ADMIN.SET_GROUPS (policy_name IN VARCHAR2,
  user_name          IN VARCHAR2,
  read_groups        IN VARCHAR2,
  write_groups       IN VARCHAR2 DEFAULT NULL,
  def_group          IN VARCHAR2 DEFAULT NULL,
  row_groups         IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-62 SA_USER_ADMIN.SET_GROUPS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user name. This user is a first-time user for group authorization, but the user must already be authorized for levels. To find users who have been authorized for levels, query the USER_NAME column of the DBA_SA_USER_LEVELS view.

Table D-62 (Cont.) SA_USER_ADMIN.SET_GROUPS Parameters

Parameter	Description
read_groups	A comma-delimited list of groups authorized for read, by short name only. To find existing groups, query the SHORT_NAME column of the ALL_SA_GROUPS view.
write_groups	A comma-delimited list of groups authorized for write, by short name only. This must be a subset of read_groups. If set to NULL, then this setting defaults to read_groups.
def_groups	Specifies the default groups, by short name only. This must be a subset of read_groups. If set to NULL, then this setting defaults to read_groups.
row_groups	Specifies the row groups, by short name only. This must be a subset of write_groups and def_groups. If set to NULL, then this setting defaults to the groups in def_groups that are authorized for write access.

Example

The following example defines groups for the hr_ols_pol policy.

```
BEGIN
  SA_USER_ADMIN.SET_GROUPS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    read_groups => 'ER_FIN',
    write_groups => 'ER_FIN',
    def_groups  => 'ER_FIN',
    row_groups  => 'ER_FIN');
END;
/
```

D.7.14 SA_USER_ADMIN.SET_LEVELS

The SA_USER_ADMIN.SET_LEVELS procedure assigns a user minimum and maximum levels and identifies default values for the user's session label and row label.

Syntax

```
SA_USER_ADMIN.SET_LEVELS (policy_name IN VARCHAR2,
  user_name           IN VARCHAR2,
  max_level           IN VARCHAR2,
  min_level           IN VARCHAR2 DEFAULT NULL,
  def_level           IN VARCHAR2 DEFAULT NULL,
  row_level           IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-63 SA_USER_ADMIN.SET_LEVELS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Table D-63 (Cont.) SA_USER_ADMIN.SET_LEVELS Parameters

Parameter	Description
user_name	Specifies the user name. This user does not need to have any Oracle Label Security authorizations before you run this procedure.
max_level	The highest level for read and write access, by short name only. To find existing levels, query the SHORT_NAME column of the ALL_SA_LEVELS view.
min_level	The lowest level for write access, by short name only. If set to NULL, then the default is the lowest level for the policy.
def_level	Specifies the default level (equal to or greater than the minimum level, and equal to or less than the maximum level). Use the short name only. If set to NULL, then the default is the max_level.
row_level	Specifies the row level (equal to or greater than the minimum level, and equal to or less than the default level). Use the short name only. If set to NULL, then it is set to the def_level.

Example

The following example sets levels for the hr_ols_pol policy.

```
BEGIN
  SA_USER_ADMIN.SET_LEVELS (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    max_level   => 'PUB',
    min_level   => 'HS');
END;
/
```

D.7.15 SA_USER_ADMIN.SET_PROG_PRIVS

The SA_USER_ADMIN.SET_PROG_PRIVS procedure sets policy-specific privileges for program units.

If the privileges parameter is NULL, then the program unit's privileges for the policy are removed.

To grant privileges to a stored program unit, you must have the policy_DBA role, and the EXECUTE permission on the SA_USER_ADMIN.SA_USER_ADMIN package. You can use either the SA_USER_ADMIN package or Oracle Enterprise Manager to manage Oracle Label Security privileges.

Syntax

```
SA_USER_ADMIN.SET_PROG_PRIVS (
  policy_name      IN VARCHAR2,
  schema_name     IN VARCHAR2,
  program_unit_name IN VARCHAR2,
  privileges       IN VARCHAR2);
```

Parameters

Table D-64 SA_USER_ADMIN.SET_PROG_PRIVS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
schema_name	The name of the schema that contains the program unit
program_unit_name	Specifies the program unit to be granted privileges
privileges	A comma-delimited character string of policy-specific privileges. If you set privileges to NULL, then the program unit's privileges for the policy are removed. See About Granting Privileges to Users and Trusted Program Units for the Policy for list of available privileges to grant.

Example

The following example gives the READ privilege to the SUM_PURCHASES function (described in [Example: Trusted Stored Program Unit](#)):

```
BEGIN
  SA_USER_ADMIN.SET_PROG_PRIVS (
    policy_name      => 'hr_ols_pol',
    schema_name      => 'HR',
    program_unit_name => 'sum_purchases',
    privileges       => 'READ');
END;
/
```

When the check_emp_hours procedure is then called, it runs with the READ privilege as well as the current user's Oracle Label Security privileges. Using this technique, the user can be allowed to find the value of the total employee hours that were logged, without learning what hours any individual employee logged.

D.7.16 SA_USER_ADMIN.SET_ROW_LABEL

The SA_USER_ADMIN.SET_ROW_LABEL procedure sets a user's initial row label to the one specified.

The user can set the row label independently, but only to:

- A level that is less than or equal to the level of the session label, and greater than or equal to the user's minimum level
- Include a subset of the compartments and groups from the session label, for which the user is authorized to have write access

If you try to set the row label to an invalid value, then the operation is disallowed, and the row label value is unchanged.

Syntax

```
SA_USER_ADMIN.SET_ROW_LABEL (
  policy_name  IN VARCHAR2,
  user_name    IN VARCHAR2,
  row_label    IN VARCHAR2);
```

Parameters

Table D-65 SA_USER_ADMIN.SET_ROW_LABEL Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user name. This user must have the sufficient compartment, group, and level authorizations. To find this user, query the USER_NAME column of the DBA_SA_USER_COMPARTMENTS, DBA_SA_USER_GROUPS, and DBA_SA_USER_LEVELS views.
row_label	Specifies the label string to be used to initialize the user's row label. The label must contain only those compartments and groups from the default label that are authorized for write access. To find existing compartments and groups, query the ALL_SA_COMPARTMENTS and ALL_SA_GROUPS views.

Example

The following example sets the row label for the hr_ols_pol policy for user jjones.

```
BEGIN
  SA_USER_ADMIN.SET_ROW_LABEL (
    policy_name => 'hr_ols_pol',
    user_name   => 'jjones',
    row_label   => 'HS');
END;
/
```

Related Topics

- [SA_SESSION.SET_ROW_LABEL](#)
The SA_SESSION.SET_ROW_LABEL procedure sets the default row label value for the current database session.

D.7.17 SA_USER_ADMIN.SET_USER_LABELS

The SA_USER_ADMIN.SET_USER_LABELS procedure sets the user's levels, compartments, and groups using a set of labels, instead of the individual components.

Syntax

```
SA_USER_ADMIN.SET_USER_LABELS (
  policy_name      IN VARCHAR2,
  user_name        IN VARCHAR2,
  max_read_label   IN VARCHAR2,
  max_write_label  IN VARCHAR2 DEFAULT NULL,
  min_write_label  IN VARCHAR2 DEFAULT NULL,
  def_label        IN VARCHAR2 DEFAULT NULL,
  row_label        IN VARCHAR2 DEFAULT NULL);
```

Parameters

Table D-66 SA_USER_ADMIN.SET_USER_LABELS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	Specifies the user name. The user can be an existing database user or an Oracle Real Application Security user. This user does not need any Oracle Label Security authorizations before you run this procedure.
max_read_label	Specifies the label string to be used to initialize the user's maximum authorized read label. Composed of the user's maximum level, compartments authorized for read access, and groups authorized for read access. To find information for these settings, query the DBA_SA_USERS data dictionary view.
max_write_label	Specifies the label string to be used to initialize the user's maximum authorized write label. Composed of the user's maximum level, compartments authorized for write access, and groups authorized for write access. If max_write_label is not specified, then it is set to max_read_label.
min_write_label	Specifies the label string to be used to initialize the user's minimum authorized write label. Contains only the level, with no compartments or groups. If min_write_label is not specified, then it is set to the lowest defined level for the policy, with no compartments or groups.
def_label	Specifies the label string to be used to initialize the user's session label, including level, compartments, and groups (a subset of max_read_label). If default_label is not specified, then it is set to max_read_label.
row_label	Specifies the label string to be used to initialize the program's row label. Includes level, components, and groups: subsets of max_write_label and def_label. If row_label is not specified, then it is set to def_label, with only the compartments and groups authorized for write access.

Examples

The following example sets user labels for the hr_ols_pol policy for user jjones.

```
BEGIN
  SA_USER_ADMIN.SET_USER_LABELS (
    policy_name      => 'hr_ols_pol',
    user_name        => 'jjones',
    max_read_label   => 'HS:FIN',
    max_write_label  => 'HS',
    def_label        => 'HS',
    row_label        => 'HS');
END;
/
```

The following example sets user labels for the XSOLSPOL1 policy for the Oracle Database Real Application Security user XSUSER1. To run the following example, you must either an Oracle Label Security administrator, be granted the LBAC_DBA database role and granted the EXECUTE

privilege, or be granted the XSOLSPOL1_DBA role and granted the EXECUTE privilege on the SA_USER_ADMIN package.

```
EXEC SA_USER_ADMIN.SET_USER_LABELS('XSOLSPOL1', 'XSUSER1', 'MID', 'MID');
```

In this specification:

- XSOLSPOL1 is the name of an existing OLS policy.
- XSUSER1 is the name of an existing Oracle Database Real Application Security user.
- MID is the value of the max_read_label.
- MID is the value of the max_write_label.

Related Topics

- [SA_USER_ADMIN.SET_PROG_PRIVS](#)
The SA_USER_ADMIN.SET_PROG_PRIVS procedure sets policy-specific privileges for program units.

D.7.18 SA_USER_ADMIN.SET_USER_PRIVS

The SA_USER_ADMIN.SET_USER_PRIVS procedure sets policy-specific privileges for users.

These privileges do not become effective until the next time the user logs into the database. The new set of privileges replaces any existing privileges. A NULL value for the privileges parameter removes the user's privileges for the policy.

To assign policy privileges to users, you must have the EXECUTE privilege for the SA_USER_ADMIN package, and must have been granted the policy_DBA role.

Syntax

```
SA_USER_ADMIN.SET_USER_PRIVS (
    policy_name      IN VARCHAR2,
    user_name        IN VARCHAR2,
    privileges       IN VARCHAR2);
```

Parameters

Table D-67 SA_USER_ADMIN.SET_USER_PRIVS Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
user_name	The name of the user to be granted privileges. The user can be an existing database user or an Oracle Real Application Security user. This user should already have been authorized for policy levels, compartments, and groups. To find this user, query the USER_NAME column of the DBA_SA_USER_COMPARTMENTS, DBA_SA_USER_GROUPS, and DBA_SA_USER_LABELS views.
privileges	A character string of policy-specific privileges separated by commas. See About Granting Privileges to Users and Trusted Program Units for the Policy for list of available privileges to grant.

Examples

The following example grants user `jgodfrey` full privileges for the `hr_ols_pol` policy settings.

```

BEGIN
  SA_USER_ADMIN.SET_USER_PRIVS (
    policy_name      => 'hr_ols_pol',
    user_name        => 'jgodfrey',
    privileges       => 'FULL');
END;
/

```

The following example grants Oracle Database Real Application Security user `XSUSER1` the `READ` privilege for the Oracle Label Security policy `XSOLSPOL1`. To run the following example, you must either be an Oracle Label Security administrator, be granted the `LBAC_DBA` database role and granted the `EXECUTE` privilege, or be granted the `XSOLSPOL1_DBA` role and granted the `EXECUTE` privilege on the `SA_USER_ADMIN` package.

```
EXEC SA_USER_ADMIN.SET_USER_PRIVS('XSOLSPOL1', 'XSUSER1', 'READ');
```

In this specification:

- `XSOLSPOL1` is the name of an existing OLS policy.
- `XSUSER1` is the name of an existing Oracle Database Real Application Security user.
- `READ` is the privilege to be granted to `XSUSER1` in OLS policy `XSOLSPOL1`.

Related Topics

- [About Granting Privileges to Users and Trusted Program Units for the Policy](#)
Certain authorized users and trusted program units may need special privileges to bypass parts of the OLS policy.

D.8 SA_UTL PL/SQL Utility Functions and Procedures

The `SA_UTL` PL/SQL package contains utility functions and procedures that are used in PL/SQL programs.

- [About the SA_UTL PL/SQL Package](#)
The `SA_UTL` PL/SQL package utility functions include returning the values such as user privileges or label information.
- [SA_UTL.CHECK_LABEL_CHANGE](#)
The `SA_UTL.CHECK_LABEL_CHANGE` function checks if the user can change the data label for a policy protected table row.
- [SA_UTL.CHECK_READ](#)
The `SA_UTL.CHECK_READ` function checks if a user can read a policy-protected table row.
- [SA_UTL.CHECK_WRITE](#)
The `SA_UTL.CHECK_WRITE` function to checks if the user can insert, update, or delete data in a policy protected table row.
- [SA_UTL.DATA_LABEL](#)
The `SA_UTL.DATA_LABEL` function returns `TRUE` if the label is a data label.
- [SA_UTL.GREATEST_LBOUND](#)
The `SA_UTL.GREATEST_LBOUND` function returns a label that is the greatest lower bound of the two label arguments.

- [SA_UTL.NUMERIC_LABEL](#)
The `SA_UTL.NUMERIC_LABEL` function returns the current session label.
- [SA_UTL.NUMERIC_ROW_LABEL](#)
The `SA_UTL.NUMERIC_ROW_LABEL` function returns the current row label. .
- [SA_UTL.SET_LABEL](#)
The `SA_UTL.SET_LABEL` procedure sets the label of the current database session.
- [SA_UTL.SET_ROW_LABEL](#)
The `SA_UTL.SET_ROW_LABEL` procedure sets the row label of the current database session.

D.8.1 About the SA_UTL PL/SQL Package

The `SA_UTL` PL/SQL package utility functions include returning the values such as user privileges or label information.

These programs return information about the current values of the session security attributes, as numeric label values. They are primarily for use in trusted stored program units. You do not need special privileges to use this package.

Related Topics

- [How Setting and Returning Label Information Works](#)
The `SA_UTL` package has functions to return information about current values of session security attributes using numeric label values.

D.8.2 SA_UTL.CHECK_LABEL_CHANGE

The `SA_UTL.CHECK_LABEL_CHANGE` function checks if the user can change the data label for a policy protected table row.

This function returns 1 if the user can change the data label. It returns 0 if the user cannot change the data label. The input values are the policy name, the current data label, and the new data label.

Syntax

```
SA_UTL.CHECK_LABEL_CHANGE (
  policy_name      IN VARCHAR2,
  current_label    IN NUMBER,
  new_label        IN NUMBER)
RETURN NUMBER;
```



Note:

You must have update privileges on the table to write any data into the table.

Parameters

Table D-68 SA_UTL.CHECK_LABEL_CHANGE Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.

Table D-68 (Cont.) SA_UTL.CHECK_LABEL_CHANGE Parameters

Parameter	Description
current_label	The current value of the label. To find existing label values, query the LABEL column of the ALL_SA_LABELS view.
new_label	The new value for the label

Example

The following example indicates if users can change data labels in policy-protected rows.

```
SET SERVEROUTPUT ON
BEGIN
  IF SA_UTL.CHECK_LABEL_CHANGE('hr_ols_pol',2000, 2200) = 1
    THEN DBMS_OUTPUT.PUT_LINE('Users can change data labels in policy-protected rows.');
```

```
ELSE
  DBMS_OUTPUT.PUT_LINE('Users cannot change data labels in policy-protected rows.');
```

```
END IF;
END;
/
```

D.8.3 SA_UTL.CHECK_READ

The SA_UTL.CHECK_READ function checks if a user can read a policy-protected table row.

This function returns 1 if the user can read the table row. It returns 0 if the user cannot read the table row.

**Note:**

The user must have the SELECT privilege on the table to read any data from the table.

Syntax

```
SA_UTL.CHECK_READ (
  policy_name    IN VARCHAR2,
  label          IN NUMBER)
RETURN NUMBER;
```

Parameters**Table D-69 SA_UTL.CHECK_READ Parameters**

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
label	The label to be checked. To find existing label values, query the LABEL column of the ALL_SA_LABELS view.

Example

The following example indicates if users can read a policy-protected row.

```
SET SERVEROUTPUT ON
BEGIN
  IF SA_UTL.CHECK_READ('hr_ols_pol',2000) = 1
    THEN DBMS_OUTPUT.PUT_LINE('Users can read policy-protected rows.');
```

D.8.4 SA_UTL.CHECK_WRITE

The SA_UTL.CHECK_WRITE function to checks if the user can insert, update, or delete data in a policy protected table row.

The user should already have the UPDATE privilege on the table to write any data into the table. This function returns 1 if the user can write to the table row. It returns 0 if the user cannot write to the table row. The input values are the policy name and the row data label.

Syntax

```
SA_UTL.CHECK_WRITE (
  policy_name      IN VARCHAR2,
  label            IN NUMBER)
RETURN NUMBER;
```

Parameters

Table D-70 SA_UTL.CHECK_WRITE Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
label	The label to be checked. To find existing label values, query the LABEL and TAG columns of the ALL_SA_LABELS view.

Example

The following example indicates if users can write to policy-protected rows.

```
SET SERVEROUTPUT ON
BEGIN
  IF SA_UTL.CHECK_WRITE('hr_ols_pol',2000) = 1
    THEN DBMS_OUTPUT.PUT_LINE('Users can write to policy-protected rows.');
```

D.8.5 SA_UTL.DATA_LABEL

The `SA_UTL.DATA_LABEL` function returns `TRUE` if the label is a data label.

Syntax

```
SA_UTL.DATA_LABEL(  
  label IN NUMBER)  
RETURN BOOLEAN;
```

Parameters

Table D-71 SA_UTL.DATA_LABEL Parameter

Parameter	Description
label	The label to be checked. To find existing label values, query the <code>LABEL</code> and <code>TAG</code> columns of the <code>ALL_SA_LABELS</code> view.

Example

The following example indicates if the label 2000 is a data label.

```
SET SERVEROUTPUT ON  
BEGIN  
  IF SA_UTL.DATA_LABEL(2000)  
    THEN DBMS_OUTPUT.PUT_LINE('Label 2000 is a data label.');
```

```
  ELSE  
    DBMS_OUTPUT.PUT_LINE('Label 2000 is not a data label.');
```

```
  END IF;  
END;  
/
```

D.8.6 SA_UTL.GREATEST_LBOUND

The `SA_UTL.GREATEST_LBOUND` function returns a label that is the greatest lower bound of the two label arguments.

Syntax

```
SA_UTL.GREATEST_LBOUND (  
  label1 IN NUMBER,  
  label2 IN NUMBER)  
RETURN NUMBER;
```

Parameters

Table D-72 SA_UTL.GREATEST_LBOUND Parameters

Parameter	Description
label1	The first label to check. To find existing label values, query the <code>LABEL</code> and <code>TAG</code> columns of the <code>ALL_SA_LABELS</code> view.
label2	The second label to check

Examples

The following example compares existing label tags 3110 and 3111.

```
SELECT SA_UTL.GREATEST_LBOUND(3110,3111) FROM DUAL;

SA_UTL.GREATEST_LBOUND(3110,3111)
-----
                               3111
```

D.8.7 SA_UTL.NUMERIC_LABEL

The SA_UTL.NUMERIC_LABEL function returns the current session label.

This function takes a policy name as the input parameter and returns a NUMBER value.

Syntax

```
SA_UTL.NUMERIC_LABEL (
    policy_name)
RETURN NUMBER;
```

Parameters

Table D-73 SA_UTL.NUMERIC_LABEL Parameter

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Example

The following example returns a the session numeric label for the user who is currently connected to the database instance.

```
SET SERVEROUTPUT ON
DECLARE
    num_label number;
BEGIN
    num_label := SA_UTL.NUMERIC_LABEL('hr_ols_pol');
    DBMS_OUTPUT.PUT_LINE('Numeric label: '||num_label);
END;
/
```

D.8.8 SA_UTL.NUMERIC_ROW_LABEL

The SA_UTL.NUMERIC_ROW_LABEL function returns the current row label. .

This function takes a policy name as the input parameter and returns a NUMBER value

Syntax

```
SA_UTL.NUMERIC_ROW_LABEL (
    policy_name)
RETURN NUMBER;
```

Parameters

Table D-74 SA_UTL.NUMERIC_ROW_LABEL Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.

Examples

The following example returns the session numeric row label for the user who is currently connected to the database instance.

```
SET SERVEROUTPUT ON
DECLARE
  num_row number;
BEGIN
  num_row := SA_UTL.NUMERIC_ROW_LABEL('hr_ols_pol');
  DBMS_OUTPUT.PUT_LINE('Numeric row label: '||num_row);
END;
/
```

D.8.9 SA_UTL.SET_LABEL

The SA_UTL.SET_LABEL procedure sets the label of the current database session.

The session's write label and row label are set to the subset of the label's compartments and groups that are authorized for write access.

Syntax

```
SA_UTL.SET_LABEL (
  policy_name IN VARCHAR2,
  label       IN LBAC_LABEL);
```

Parameters

Table D-75 SA_UTL.SET_LABEL Parameters

Parameter	Description
policy_name	Specifies the policy. To find existing policies, query the POLICY_NAME column of the ALL_SA_POLICIES data dictionary view.
label	The label to set as the session label. To find existing label values, query the LABEL column of the ALL_SA_LABELS view. You must pass this parameter through as an output of the TO_LBAC_DATA_LABEL function, which converts a label in character form to an LBAC_LABEL type. (The example in the next section shows how to do this.)

Example

The following example sets the label for the hr_ols_pol policy.

```
BEGIN
  SA_UTL.SET_LABEL (
```

```

    policy_name => 'hr_ols_pol',
    label       => to_lbac_data_label('hr_ols_pol','hs:pii');
END;
/

```

Related Topics

- [How Labeling Functions in Oracle Label Security Policies Works](#)
Labeling functions enable you to consider, in your rules for assigning labels, information drawn from the application context.

D.8.10 SA_UTL.SET_ROW_LABEL

The `SA_UTL.SET_ROW_LABEL` procedure sets the row label of the current database session.

The compartments and groups in the label must be a subset of compartments and groups in the session label that are authorized for write access.

Syntax

```

SA_UTL.SET_ROW_LABEL (
    policy_name IN VARCHAR2,
    label       IN BINARY_INTEGER);

```

Parameters

Table D-76 SA_UTL.SET_ROW_LABEL Parameters

Parameter	Description
<code>policy_name</code>	Specifies the policy. To find existing policies, query the <code>POLICY_NAME</code> column of the <code>ALL_SA_POLICIES</code> data dictionary view.
<code>label</code>	The label to set as the session default row label. To find existing label values, query the <code>LABEL</code> column of the <code>ALL_SA_LABELS</code> view.

Example

The following example sets the row label for the `hr_ols_pol` policy to 1111.

```

BEGIN
    SA_UTL.SET_ROW_LABEL (
        policy_name      => 'hr_ols_pol',
        label            => 1111);
END;
/

```

Related Topics

- [SA_SESSION Session Management PL/SQL Package](#)
The `SA_SESSION` PL/SQL package manages session behavior for user authorizations.

E

Oracle Label Security Tables and Views

Oracle Label Security provides data dictionary tables, data dictionary views, and an user-created auditing view.

- [Oracle Database Data Dictionary Tables](#)
Oracle Label Security does not label the Oracle data dictionary tables; access is controlled by standard Oracle Database system and object privileges.
- [Oracle Label Security Data Dictionary Views](#)
Oracle Label Security maintains an independent set of data dictionary views, which are exempt from any policy enforcement.
- [Oracle Label Security User-Created Auditing View](#)
The `SA_AUDIT_ADMIN.CREATE_VIEW` procedure can be used to create an audit trail view for a specific policy.

E.1 Oracle Database Data Dictionary Tables

Oracle Label Security does not label the Oracle data dictionary tables; access is controlled by standard Oracle Database system and object privileges.



See Also:

Oracle Database Reference for detailed information about all data dictionary tables and views

E.2 Oracle Label Security Data Dictionary Views

Oracle Label Security maintains an independent set of data dictionary views, which are exempt from any policy enforcement.

Access to the data dictionary views is granted by default to the `SELECT_CATALOG_ROLE`, a standard Oracle Database role that lets you examine the Oracle Database data dictionary.

- [About Oracle Label Security Data Dictionary Views](#)
The Oracle Label Security data dictionary views are used only for traditional auditing configurations.
- [ALL_SA_AUDIT_OPTIONS View](#)
The `ALL_SA_AUDIT_OPTIONS` data dictionary view shows for the current user Oracle Label Security auditing options, based on the `SA_AUDIT_ADMIN.AUDIT` procedure settings.
- [ALL_SA_COMPARTMENTS](#)
The `ALL_SA_COMPARTMENTS` data dictionary view shows information for the current user about Oracle Label Security policy compartments, based on the `SA_COMPONENTS.CREATE_COMPARTMENT` procedure settings.

- [ALL_SA_DATA_LABELS](#)
The `ALL_SA_DATA_LABELS` data dictionary view shows for the current user Oracle Label Security policy labels and tags, based on the `SA_LABEL_ADMIN.CREATE_LABEL` procedure settings.
- [ALL_SA_GROUPS](#)
The `ALL_SA_GROUPS` data dictionary shows information about the current user's Oracle Label Security policy groups, based on the `SA_COMPONENTS.CREATE_GROUP` and `SA_COMPONENTS.ALTER_GROUP_PARENT` procedures.
- [ALL_SA_LABELS](#)
The `ALL_SA_LABELS` data dictionary view shows for the current user information about the tags and types of labels, based on `SA_LABEL_ADMIN.CREATE_LABEL` and `SA_LABEL_ADMIN.ALTER_LABEL`.
- [ALL_SA_LEVELS](#)
The `ALL_SA_LEVELS` data dictionary view shows for the current user information about levels, based on the `SA_COMPONENTS.CREATE_LEVEL` procedure.
- [ALL_SA_POLICIES](#)
The `ALL_SA_POLICIES` data dictionary view shows for the current user information about Oracle Label Security policies, based on the `SA_SYSDBA.CREATE_POLICY` procedure.
- [ALL_SA_PROG_PRIVS](#)
The `ALL_SA_PROG_PRIVS` data dictionary view shows for the current user information about the policy-specific privileges for program units, based on `SA_USER_ADMIN.SET_PROG_PRIVS`.
- [ALL_SA_SCHEMA_POLICIES](#)
The `ALL_SA_SCHEMA_POLICIES` data dictionary view shows for the current user information about policies applied to all tables in the schema, based on `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY`.
- [ALL_SA_TABLE_POLICIES](#)
The `ALL_SA_TABLE_POLICIES` data dictionary view shows for the current user information about a policy added to a database table, based `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` settings.
- [ALL_SA_USERS](#)
The `ALL_SA_USERS` data dictionary view shows for the current user information about Oracle Label Security user privileges, based on `SA_USER_ADMIN.SET_USER_LABELS` and `SA_USER_ADMIN.SET_USER_PRIVS`.
- [ALL_SA_USER_LABELS](#)
The `ALL_SA_USER_LABELS` data dictionary view shows for the current user label-specific information about users, based on the `SA_USER_ADMIN.SET_USER_` procedure settings.
- [ALL_SA_USER_LEVELS](#)
The `ALL_SA_USER_LEVELS` data dictionary view shows for the current user the minimum and maximum levels assigned to users, based on the `SA_USER_ADMIN.SET_LEVELS` procedure.
- [ALL_SA_USER_PRIVS](#)
The `ALL_SA_USER_PRIVS` data dictionary view shows for the current user policy-specific privileges granted to users, based on the `SA_USER_ADMIN.SET_USER_PRIVS` procedure.
- [DBA_SA_AUDIT_OPTIONS](#)
The `DBA_SA_AUDIT_OPTIONS` data dictionary view data dictionary view shows for the entire database the Oracle Label Security audit options.
- [DBA_SA_COMPARTMENTS](#)
The `ALL_SA_COMPARTMENTS` data dictionary view shows for the entire database information about Oracle Label Security policy compartments.

- [DBA_SA_DATA_LABELS](#)
The `ALL_SA_DATA_LABELS` data dictionary view shows for the entire database the labels and label tags for the specified Oracle Label Security policy.
- [DBA_SA_GROUPS](#)
The `ALL_SA_GROUPS` data dictionary view shows for the entire database information about Oracle Label Security policy groups.
- [DBA_SA_GROUP_HIERARCHY](#)
The `DBA_SA_GROUP_HIERARCHY` data dictionary view shows the hierarchy of groups (that is, parent-child relationships) in a policy.
- [DBA_SA_LABELS](#)
The `DBA_SA_LABELS` data dictionary view shows for the entire database information about the tags and types of labels for a policy.
- [DBA_SA_LEVELS](#)
The `DBA_SA_LEVELS` data dictionary view shows for the entire database information about levels associated with a policy.
- [DBA_SA_POLICIES](#)
The `DBA_SA_POLICIES` data dictionary view shows for the entire database information about Oracle Label Security policies, based on the `SA_SYSDBA.CREATE_POLICY` procedure.
- [DBA_SA_PROG_PRIVS](#)
The `DBA_SA_PROG_PRIVS` data dictionary view shows for the entire database information about the policy-specific privileges for program units.
- [DBA_SA_SCHEMA_POLICIES](#)
The `DBA_SA_SCHEMA_POLICIES` data dictionary view shows for the entire database information about policies that have been applied to all tables in the schema.
- [DBA_SA_TABLE_POLICIES](#)
The `DBA_SA_TABLE_POLICIES` data dictionary view shows for the entire database information about a policy that has been added to a database table.
- [DBA_SA_USERS](#)
The `DBA_SA_USERS` data dictionary view shows for the entire database information about the privileges that Oracle Label Security users have.
- [DBA_SA_USER_COMPARTMENTS](#)
The `DBA_SA_USER_COMPARTMENTS` data dictionary view shows for the entire database the user authorizations, based on the `SA_USER_ADMIN.ADD_COMPARTMENTS` procedure.
- [DBA_SA_USER_GROUPS](#)
The `DBA_SA_USER_GROUPS` data dictionary view shows for the entire database the groups associated with users, based on the `SA_USER_ADMIN.ADD_GROUPS` procedure.
- [DBA_SA_USER_LABELS](#)
The `DBA_SA_USER_LABELS` data dictionary view shows for the entire database label-specific information about users.
- [DBA_SA_USER_LEVELS](#)
The `DBA_SA_USER_LEVELS` data dictionary view shows for the entire database the minimum and maximum levels that have been assigned to users.
- [DBA_SA_USER_PRIVS](#)
The `DBA_SA_USER_PRIVS` data dictionary view shows for the current user the policy-specific privileges that have been granted to users.

- **DBA_OLS_STATUS**
The `DBA_OLS_STATUS` data dictionary view shows the configuration status of Oracle Label Security in the database.
- **USER_SA_SESSION**
The `USER_SA_SESSION` data dictionary view shows the security attribute values for the current database session.

E.2.1 About Oracle Label Security Data Dictionary Views

The Oracle Label Security data dictionary views are used only for traditional auditing configurations.

Even though traditional auditing is desupported (starting with Oracle Database 23ai), the Oracle Label Security data dictionary views will continue to capture audit records for any current existing traditional Label Security audit settings. Audit records for any Label Security unified audit policies are written to the unified audit trail.

E.2.2 ALL_SA_AUDIT_OPTIONS View

The `ALL_SA_AUDIT_OPTIONS` data dictionary view shows for the current user Oracle Label Security auditing options, based on the `SA_AUDIT_ADMIN.AUDIT` procedure settings.

Note:

This view captures audit records from existing traditional audit configurations. You cannot configure new audit configurations using the Oracle Label Security PL/SQL packages. You must create new audit configurations only with unified auditing. Unified audit records are written to the unified audit trail views, such as `UNIFIED_AUDIT_TRAIL`.

This view displays whether auditing is configured to generate audit records per session (`BY SESSION`) or per access (`BY ACCESS`) and for successful or unsuccessful operations. Possible values are as follows:

- A dash (-) indicates that the audit option is not set.
- The `S` character indicates that the audit option is set `BY SESSION`.
- The `A` character indicates that the audit option is set `BY ACCESS`.
- Each audit option has two possible settings, `WHENEVER SUCCESSFUL` and `WHENEVER NOT SUCCESSFUL`, separated by a slash (/).

For example, in the following output, user `jjones` is audited with the `BY ACCESS` audit type for successful actions involving policy-specific privileges. User `rlayton` is audited with the `BY SESSION` audit type: audit records are written for failed attempts to remove policies and for successful attempts at setting user authorizations.

```
SELECT * FROM DBA_SA_AUDIT_OPTIONS;
```

POLICY_NAME	USER_NAME	APY	REM	SET_	PRV
HR_OLS_POL	JJONES	-/-	-/-	-/-	A/-
HR_OLS_POL	RLAYTON	-/-	-/S	S/-	-/-

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
USER_NAME	VARCHAR2 (128)	NOT NULL	Name of the user associated with the policy
APY	VARCHAR2 (3)	NULL	Audit option; refers to the application of specified Oracle Label Security policies to tables and schemas
REM	VARCHAR2 (3)	NULL	Audit option; refers to the removal of specified Oracle Label Security policies from tables and schemas
SET_	VARCHAR2 (3)	NULL	Audit option; refers to the setting of user authorizations, and user and program privileges
PRV	VARCHAR2 (3)	NULL	Audit option; refers to the use of all policy-specific privileges

E.2.3 ALL_SA_COMPARTMENTS

The `ALL_SA_COMPARTMENTS` data dictionary view shows information for the current user about Oracle Label Security policy compartments, based on the `SA_COMPONENTS.CREATE_COMPARTMENT` procedure settings.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
COMP_NUM	NUMBER (4)	NOT NULL	Compartment number in the range of (0-9999)
SHORT_NAME	VARCHAR2 (30)	NOT NULL	Short name for the compartment
LONG_NAME	VARCHAR2 (80)	NOT NULL	Long name for the compartment

Related Topics

- [SA_COMPONENTS.CREATE_COMPARTMENT](#)
The `SA_COMPONENTS.CREATE_COMPARTMENT` procedure creates a compartment and specify its short name and long name.

E.2.4 ALL_SA_DATA_LABELS

The `ALL_SA_DATA_LABELS` data dictionary view shows for the current user Oracle Label Security policy labels and tags, based on the `SA_LABEL_ADMIN.CREATE_LABEL` procedure settings.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
LABEL	VARCHAR2 (4000)	NULL	Short name of the level, compartment, or group that was specified as the label value

Column	Datatype	Null	Description
LABEL_TAG	NUMBER	NULL	Integer that represents the sort order of the label, relative to other policy labels (0-99999999)

Related Topics

- [SA_LABEL_ADMIN.CREATE_LABEL](#)
The `SA_LABEL_ADMIN.CREATE_LABEL` procedure creates data labels.

E.2.5 ALL_SA_GROUPS

The `ALL_SA_GROUPS` data dictionary shows information about the current user's Oracle Label Security policy groups, based on the `SA_COMPONENTS.CREATE_GROUP` and `SA_COMPONENTS.ALTER_GROUP_PARENT` procedures.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
GROUP_NUM	NUMBER (4)	NOT NULL	Group number (0-9999)
SHORT_NAME	VARCHAR2 (30)	NOT NULL	Short name of the group
LONG_NAME	VARCHAR2 (80)	NOT NULL	Long name of the group
PARENT_NUM	NUMBER (4)	NULL	Numerical ID for the associated parent group
PARENT_NAME	VARCHAR2 (30)	NULL	Name of the group assigned as the parent for the group

Related Topics

- [SA_COMPONENTS.CREATE_GROUP](#)
The `SA_COMPONENTS.CREATE_GROUP` procedure creates a group and specify its short name and long name, and optionally a parent group.
- [SA_COMPONENTS.ALTER_GROUP_PARENT](#)
The `SA_COMPONENTS.ALTER_GROUP_PARENT` procedure changes the parent group associated with a particular group.

E.2.6 ALL_SA_LABELS

The `ALL_SA_LABELS` data dictionary view shows for the current user information about the tags and types of labels, based on `SA_LABEL_ADMIN.CREATE_LABEL` and `SA_LABEL_ADMIN.ALTER_LABEL`.

Access to `ALL_SA_LABELS` is PUBLIC. However, only the labels authorized for read access by the session are visible.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
LABEL	VARCHAR2 (4000)	NOT NULL	Short name of the level associated with this label

Column	Datatype	Null	Description
LABEL_TAG	NUMBER(30)	NOT NULL	Integer tag assigned to the label
LABEL_TYPE	VARCHAR2(15)	NULL	Type of label

Related Topics

- [SA_LABEL_ADMIN.CREATE_LABEL](#)
The `SA_LABEL_ADMIN.CREATE_LABEL` procedure creates data labels.
- [SA_LABEL_ADMIN.ALTER_LABEL](#)
The `SA_LABEL_ADMIN.ALTER_LABEL` procedure changes the character string label definition associated with a label tag.

E.2.7 ALL_SA_LEVELS

The `ALL_SA_LEVELS` data dictionary view shows for the current user information about levels, based on the `SA_COMPONENTS.CREATE_LEVEL` procedure.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2(30)	NOT NULL	Name of the Oracle Label Security policy
LEVEL_NUM	NUMBER(4)	NOT NULL	Level number (0-9999)
SHORT_NAME	VARCHAR2(30)	NOT NULL	Short name for the level
LONG_NAME	VARCHAR2(80)	NOT NULL	Long name for the level

Related Topics

- [SA_COMPONENTS.CREATE_LEVEL](#)
The `SA_COMPONENTS.CREATE_LEVEL` procedure creates a level and specify its short name and long name.

E.2.8 ALL_SA_POLICIES

The `ALL_SA_POLICIES` data dictionary view shows for the current user information about Oracle Label Security policies, based on the `SA_SYSDBA.CREATE_POLICY` procedure.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2(30)	NOT NULL	Name of the Oracle Label Security policy
COLUMN_NAME	VARCHAR2(128)	NOT NULL	Name of the column that was added to tables protected by the policy
STATUS	VARCHAR2(8)	NULL	Whether the policy has been enabled or disabled
POLICY_OPTIONS	VARCHAR2(4000)	NULL	Options that were set for this policy See Categories of Policy Enforcement Options for a listing of the possible enforcement options.

Related Topics

- [SA_SYSDBA.CREATE_POLICY](#)
The `SA_SYSDBA.CREATE_POLICY` procedure creates a new Oracle Label Security policy, defines a policy-specific column name, and specifies default policy options.

E.2.9 ALL_SA_PROG_PRIVS

The `ALL_SA_PROG_PRIVS` data dictionary view shows for the current user information about the policy-specific privileges for program units, based on `SA_USER_ADMIN.SET_PROG_PRIVS`.

Column	Datatype	Null	Description
<code>SCHEMA_NAME</code>	<code>VARCHAR2(128)</code>	NOT NULL	Name of the schema that contains the program unit
<code>PROGRAM_NAME</code>	<code>VARCHAR(128)</code>	NOT NULL	Program unit that was granted privileges
<code>POLICY_NAME</code>	<code>VARCHAR2(30)</code>	NOT NULL	Name of the Oracle Label Security policy
<code>PROGRAM_PRIVILEGES</code>	<code>VARCHAR2(4000)</code>	NULL	Policy-specific privileges. See About Granting Privileges to Users and Trusted Program Units for the Policy for list of possible privileges.

Related Topics

- [SA_USER_ADMIN.SET_PROG_PRIVS](#)
The `SA_USER_ADMIN.SET_PROG_PRIVS` procedure sets policy-specific privileges for program units.

E.2.10 ALL_SA_SCHEMA_POLICIES

The `ALL_SA_SCHEMA_POLICIES` data dictionary view shows for the current user information about policies applied to all tables in the schema, based on `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY`.

Column	Datatype	Null	Description
<code>POLICY_NAME</code>	<code>VARCHAR2(30)</code>	NOT NULL	Name of the Oracle Label Security policy
<code>SCHEMA_NAME</code>	<code>VARCHAR2(128)</code>	NOT NULL	Name of the schema associated with this policy
<code>STATUS</code>	<code>VARCHAR2(8)</code>	NULL	Whether the policy has been enabled or disabled for the schema (by the <code>SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY</code> or <code>SA_POLICY_ADMIN.DISABLE_SCHEMA_POLICY</code> for procedure)
<code>SCHEMA_OPTIONS</code>	<code>VARCHAR2(4000)</code>	NULL	Options that have been applied.

Related Topics

- [SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY` procedure applies a policy to all of the tables in a schema and enables the policy for these tables.

- [Categories of Policy Enforcement Options](#)
Oracle Label Security enforces policies using three categories: label management options, access control options, and overriding options.

E.2.11 ALL_SA_TABLE_POLICIES

The `ALL_SA_TABLE_POLICIES` data dictionary view shows for the current user information about a policy added to a database table, based `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` settings.

Column	Datatype	Null	Description
<code>POLICY_NAME</code>	<code>VARCHAR2 (30)</code>	NOT NULL	Name of the Oracle Label Security policy
<code>SCHEMA_NAME</code>	<code>VARCHAR2 (128)</code>	NOT NULL	Schema that contains the table that the policy protects
<code>TABLE_NAME</code>	<code>VARCHAR2 (128)</code>	NOT NULL	Table to be protected by the policy
<code>STATUS</code>	<code>VARCHAR2 (8)</code>	NULL	Whether the policy has been enabled or disabled for the table (by the <code>SA_POLICY_ADMIN.APPLY_TABLE_POLICY</code> or <code>SA_POLICY_ADMIN.DISABLE_TABLE_POLICY</code> for procedure)
<code>TABLE_OPTIONS</code>	<code>VARCHAR2 (4000)</code>	NULL	Policy enforcement options to be used for the table
<code>FUNCTION</code>	<code>VARCHAR2 (1024)</code>	NULL	Name of the function to return a label value to use as the default
<code>PREDICATE</code>	<code>VARCHAR2 (256)</code>	NULL	Predicate to combine (using <code>AND</code> or <code>OR</code>) with the label-based predicate for <code>READ_CONTROL</code>

Related Topics

- [SA_POLICY_ADMIN.APPLY_TABLE_POLICY](#)
The `SA_POLICY_ADMIN.APPLY_TABLE_POLICY` procedure adds the specified policy to a table.
- [Categories of Policy Enforcement Options](#)
Oracle Label Security enforces policies using three categories: label management options, access control options, and overriding options.

E.2.12 ALL_SA_USERS

The `ALL_SA_USERS` data dictionary view shows for the current user information about Oracle Label Security user privileges, based on `SA_USER_ADMIN.SET_USER_LABELS` and `SA_USER_ADMIN.SET_USER_PRIVS`.

Column	Type	Null	Description
<code>USER_NAME</code>	<code>VARCHAR2 (1024)</code>	NOT NULL	Name of the user
<code>POLICY_NAME</code>	<code>VARCHAR2 (30)</code>	NOT NULL	Name of the Oracle Label Security policy
<code>USER_PRIVILEGES</code>	<code>VARCHAR2 (4000)</code>	NULL	Policy-specific privileges granted to the user.
<code>MAX_READ_LABEL</code>	<code>VARCHAR2 (4000)</code>	NULL	Label string to initialize the user's maximum authorized read label

Column	Type	Null	Description
MAX_WRITE_LABEL	VARCHAR2 (4000)	NULL	Label string to initialize the user's maximum authorized write label
MIN_WRITE_LABEL	VARCHAR2 (4000)	NULL	Label string to initialize the user's minimum authorized write label
DEFAULT_READ_LABEL	VARCHAR2 (4000)	NULL	Label string to initialize the user's session label, including level, compartments, and groups, for read access
DEFAULT_WRITE_LABEL	VARCHAR2 (4000)	NULL	Label string to initialize the user's session label, including level, compartments, and groups, for write access
DEFAULT_ROW_LABEL	VARCHAR2 (4000)	NULL	Label string to initialize the program's row label; includes level, components, and groups
USER_LABELS	VARCHAR2 (4000)	NULL	Retained solely for backward compatibility and will be removed in the next release. The USER_LABELS column is deprecated starting with Oracle Database 18c because it is redundant. The information in this column is displayed in other ALL_SA_USERS and DBA_SA_USERS columns.

Related Topics

- [SA_USER_ADMIN.SET_USER_LABELS](#)
The SA_USER_ADMIN.SET_USER_LABELS procedure sets the user's levels, compartments, and groups using a set of labels, instead of the individual components.
- [SA_USER_ADMIN.SET_USER_PRIVS](#)
The SA_USER_ADMIN.SET_USER_PRIVS procedure sets policy-specific privileges for users.
- [About Granting Privileges to Users and Trusted Program Units for the Policy](#)
Certain authorized users and trusted program units may need special privileges to bypass parts of the OLS policy.

E.2.13 ALL_SA_USER_LABELS

The ALL_SA_USER_LABELS data dictionary view shows for the current user label-specific information about users, based on the SA_USER_ADMIN.SET_USER_ procedure settings.

Column	Datatype	Null	Description
USER_NAME	VARCHAR2 (1024)	NOT NULL	Name of the user
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
MAX_READ_LABEL	VARCHAR2 (4000)	NOT NULL	Label string to initialize the user's maximum authorized read label
MAX_WRITE_LABEL	VARCHAR2 (4000)	NULL	Label string to initialize the user's maximum authorized write label

Column	Datatype	Null	Description
MIN_WRITE_LABEL	VARCHAR2(4000)	NULL	Label string to initialize the user's minimum authorized write label
DEFAULT_READ_LABEL	VARCHAR2(4000)	NULL	Label string to initialize the user's session label, including level, compartments, and groups, for read access
DEFAULT_WRITE_LABEL	VARCHAR2(4000)	NULL	Label string to initialize the user's session label, including level, compartments, and groups, for write access
DEFAULT_ROW_LABEL	VARCHAR2(4000)	NULL	Label string to initialize the program's row label; includes level, components, and groups

Related Topics

- [SA_USER_ADMIN.SET_USER_LABELS](#)
The `SA_USER_ADMIN.SET_USER_LABELS` procedure sets the user's levels, compartments, and groups using a set of labels, instead of the individual components.

E.2.14 ALL_SA_USER_LEVELS

The `ALL_SA_USER_LEVELS` data dictionary view shows for the current user the minimum and maximum levels assigned to users, based on the `SA_USER_ADMIN.SET_LEVELS` procedure.

It also lists the user's session label and row label default values.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2(30)	NOT NULL	Name of the Oracle Label Security policy
USER_NAME	VARCHAR2(1024)	NOT NULL	Name of the user
MAX_LEVEL	VARCHAR2(30)	NOT NULL	Short name of the highest level for read and write access
MIN_LEVEL	VARCHAR2(30)	NOT NULL	Short name of the lowest level for read and write access
DEF_LEVEL	VARCHAR2(30)	NOT NULL	Short name of the default level
ROW_LEVEL	VARCHAR2(30)	NOT NULL	Short name of the row level

Related Topics

- [SA_USER_ADMIN.SET_LEVELS](#)
The `SA_USER_ADMIN.SET_LEVELS` procedure assigns a user minimum and maximum levels and identifies default values for the user's session label and row label.

E.2.15 ALL_SA_USER_PRIVS

The `ALL_SA_USER_PRIVS` data dictionary view shows for the current user policy-specific privileges granted to users, based on the `SA_USER_ADMIN.SET_USER_PRIVS` procedure.

Column	Datatype	Null	Description
USER_NAME	VARCHAR2(1024)	NOT NULL	Name of the user
POLICY_NAME	VARCHAR2(30)	NOT NULL	Name of the Oracle Label Security policy
USER_PRIVILEGE S	VARCHAR2(4000)	NULL	Policy-specific privileges granted to the user

Related Topics

- [SA_USER_ADMIN.SET_USER_PRIVS](#)
The `SA_USER_ADMIN.SET_USER_PRIVS` procedure sets policy-specific privileges for users.
- [About Granting Privileges to Users and Trusted Program Units for the Policy](#)
Certain authorized users and trusted program units may need special privileges to bypass parts of the OLS policy.

E.2.16 DBA_SA_AUDIT_OPTIONS

The `DBA_SA_AUDIT_OPTIONS` data dictionary view shows for the entire database the Oracle Label Security audit options.

Note:

This view captures audit records from existing traditional audit configurations. You cannot configure new audit configurations using the Oracle Label Security PL/SQL packages. You must create new audit configurations only with unified auditing. Unified audit records are written to the unified audit trail views, such as `UNIFIED_AUDIT_TRAIL`.

The columns for this view are the same as `ALL_SA_AUDIT_OPTIONS`.

Related Topics

- [ALL_SA_AUDIT_OPTIONS View](#)
The `ALL_SA_AUDIT_OPTIONS` data dictionary view shows for the current user Oracle Label Security auditing options, based on the `SA_AUDIT_ADMIN.AUDIT` procedure settings.

E.2.17 DBA_SA_COMPARTMENTS

The `ALL_SA_COMPARTMENTS` data dictionary view shows for the entire database information about Oracle Label Security policy compartments.

Its columns are the same as `ALL_SA_COMPARTMENTS`.

Related Topics

- [ALL_SA_COMPARTMENTS](#)
The `ALL_SA_COMPARTMENTS` data dictionary view shows information for the current user about Oracle Label Security policy compartments, based on the `SA_COMPONENTS.CREATE_COMPARTMENT` procedure settings.

E.2.18 DBA_SA_DATA_LABELS

The `ALL_SA_DATA_LABELS` data dictionary view shows for the entire database the labels and label tags for the specified Oracle Label Security policy.

Its columns are the same as `ALL_SA_DATA_LABELS`.

Related Topics

- [ALL_SA_DATA_LABELS](#)
The `ALL_SA_DATA_LABELS` data dictionary view shows for the current user Oracle Label Security policy labels and tags, based on the `SA_LABEL_ADMIN.CREATE_LABEL` procedure settings.

E.2.19 DBA_SA_GROUPS

The `ALL_SA_GROUPS` data dictionary view shows for the entire database information about Oracle Label Security policy groups.

Its columns are the same as `ALL_SA_GROUPS`.

Related Topics

- [ALL_SA_GROUPS](#)
The `ALL_SA_GROUPS` data dictionary shows information about the current user's Oracle Label Security policy groups, based on the `SA_COMPONENTS.CREATE_GROUP` and `SA_COMPONENTS.ALTER_GROUP_PARENT` procedures.

E.2.20 DBA_SA_GROUP_HIERARCHY

The `DBA_SA_GROUP_HIERARCHY` data dictionary view shows the hierarchy of groups (that is, parent-child relationships) in a policy.

Column	Type	Null	Description
<code>POLICY_NAME</code>	<code>VARCHAR2(30)</code>	NOT NULL	Name of the Oracle Label Security policy
<code>HIERARCHY_LEVEL</code>	<code>NUMBER</code>	NULL	Indicates the level of a particular group in a group hierarchy. A group with no parent group will have <code>HIERARCHY_LEVEL</code> 1. Its child group will have <code>HIERARCHY_LEVEL</code> 2 and so on. For example, consider these groups in the following order: <ol style="list-style-type: none"> 1. G1, G4 2. G2, G5 3. G3 Here, G1 and G4 have <code>HIERARCHY_LEVEL</code> 1; G2 and G5 have <code>HIERARCHY_LEVEL</code> 2, and G3 has <code>HIERARCHY_LEVEL</code> 3. The parent-child relationships are: <ul style="list-style-type: none"> • G3 is the child group of G2, and G2 is the child group of G1. • G5 is the child group of G4.

Column	Type	Null	Description
GROUP_NAME	VARCHAR2 (4000)	NULL	Short name of the group intended to indicate the hierarchy level

E.2.21 DBA_SA_LABELS

The `DBA_SA_LABELS` data dictionary view shows for the entire database information about the tags and types of labels for a policy.

Its columns are the same as `ALL_SA_LABELS`.

Related Topics

- [ALL_SA_LABELS](#)
The `ALL_SA_LABELS` data dictionary view shows for the current user information about the tags and types of labels, based on `SA_LABEL_ADMIN.CREATE_LABEL` and `SA_LABEL_ADMIN.ALTER_LABEL`.

E.2.22 DBA_SA_LEVELS

The `DBA_SA_LEVELS` data dictionary view shows for the entire database information about levels associated with a policy.

Its columns are the same as `ALL_SA_LEVELS`.

Related Topics

- [ALL_SA_LABELS](#)
The `ALL_SA_LABELS` data dictionary view shows for the current user information about the tags and types of labels, based on `SA_LABEL_ADMIN.CREATE_LABEL` and `SA_LABEL_ADMIN.ALTER_LABEL`.

E.2.23 DBA_SA_POLICIES

The `DBA_SA_POLICIES` data dictionary view shows for the entire database information about Oracle Label Security policies, based on the `SA_SYSDBA.CREATE_POLICY` procedure.

This view also shows whether the policy has been enabled or disabled and its subscription status.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
COLUMN_NAME	VARCHAR2 (128)	NOT NULL	Name of the column that was added to tables protected by the policy
STATUS	VARCHAR2 (8)	NULL	Whether the policy has been enabled or disabled
POLICY_OPTIONS	VARCHAR2 (4000)	NULL	Options that were set for this policy. See Categories of Policy Enforcement Options for a listing of the possible enforcement options.

Column	Datatype	Null	Description
POLICY_SUBSCRIBED	VARCHAR2 (5)	NULL	Indicates the policy's subscription status, based on the SA_POLICY_ADMIN.POLICY_SUBSCRIBED or SA_POLICY_ADMIN.POLICY_UNSUBSCRIBE procedure

E.2.24 DBA_SA_PROG_PRIVS

The `DBA_SA_PROG_PRIVS` data dictionary view shows for the entire database information about the policy-specific privileges for program units.

Its columns are the same as `ALL_SA_PROG_PRIVS`.

Related Topics

- [ALL_SA_PROG_PRIVS](#)
The `ALL_SA_PROG_PRIVS` data dictionary view shows for the current user information about the policy-specific privileges for program units, based on `SA_USER_ADMIN.SET_PROG_PRIVS`.

E.2.25 DBA_SA_SCHEMA_POLICIES

The `DBA_SA_SCHEMA_POLICIES` data dictionary view shows for the entire database information about policies that have been applied to all tables in the schema.

Its columns are the same as `ALL_SA_SCHEMA_POLICIES`.

Related Topics

- [ALL_SA_SCHEMA_POLICIES](#)
The `ALL_SA_SCHEMA_POLICIES` data dictionary view shows for the current user information about policies applied to all tables in the schema, based on `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY`.

E.2.26 DBA_SA_TABLE_POLICIES

The `DBA_SA_TABLE_POLICIES` data dictionary view shows for the entire database information about a policy that has been added to a database table.

Its columns are the same as `ALL_SA_TABLE_POLICIES`.

Related Topics

- [ALL_SA_SCHEMA_POLICIES](#)
The `ALL_SA_SCHEMA_POLICIES` data dictionary view shows for the current user information about policies applied to all tables in the schema, based on `SA_POLICY_ADMIN.APPLY_SCHEMA_POLICY`.

E.2.27 DBA_SA_USERS

The `DBA_SA_USERS` data dictionary view shows for the entire database information about the privileges that Oracle Label Security users have.

Its columns are the same as `ALL_SA_USERS`.

Related Topics

- [ALL_SA_USERS](#)
The `ALL_SA_USERS` data dictionary view shows for the current user information about Oracle Label Security user privileges, based on `SA_USER_ADMIN.SET_USER_LABELS` and `SA_USER_ADMIN.SET_USER_PRIVS`.

E.2.28 DBA_SA_USER_COMPARTMENTS

The `DBA_SA_USER_COMPARTMENTS` data dictionary view shows for the entire database the user authorizations, based on the `SA_USER_ADMIN.ADD_COMPARTMENTS` procedure.

This view also indicates whether the compartments are authorized for write and read privileges

Column	Datatype	Null	Description
<code>POLICY_NAME</code>	<code>VARCHAR2(30)</code>	NOT NULL	Name of the Oracle Label Security policy
<code>USER_NAME</code>	<code>VARCHAR2(1024)</code>	NOT NULL	Name of the user
<code>COMP</code>	<code>VARCHAR2(30)</code>	NOT NULL	Short name of compartments that were added
<code>RW_ACCESS</code>	<code>VARCHAR2(5)</code>	NULL	Access mode. Possible values are: <ul style="list-style-type: none"> • <code>SA_UTL.READ_ONLY</code> indicates no write access • <code>SA_UTL.READ_WRITE</code> indicates that write is authorized
<code>DEF_COMP</code>	<code>VARCHAR2(1)</code>	NOT NULL	Whether the compartments are in the default compartments
<code>ROW_COMP</code>	<code>VARCHAR2(1)</code>	NOT NULL	whether the compartments are in the row label

Related Topics

- [SA_USER_ADMIN.ADD_COMPARTMENTS](#)
The `SA_USER_ADMIN.ADD_COMPARTMENTS` procedure adds (assigns) compartments to a user's authorizations, indicating if the compartments are authorized for write and read privileges.

E.2.29 DBA_SA_USER_GROUPS

The `DBA_SA_USER_GROUPS` data dictionary view shows for the entire database the groups associated with users, based on the `SA_USER_ADMIN.ADD_GROUPS` procedure.

Column	Datatype	Null	Description
<code>POLICY_NAME</code>	<code>VARCHAR2(30)</code>	NOT NULL	Name of the Oracle Label Security policy
<code>USER_NAME</code>	<code>VARCHAR2(1024)</code>	NOT NULL	Name of the user
<code>GRP</code>	<code>VARCHAR2(30)</code>	NOT NULL	Short name of groups that were added
<code>RW_ACCESS</code>	<code>VARCHAR2(5)</code>	NULL	Access mode. Possible values are: <ul style="list-style-type: none"> • <code>SA_UTL.READ_ONLY</code> indicates read-only access • <code>SA_UTL.READ_WRITE</code> indicates read and write access
<code>DEF_GROUP</code>	<code>VARCHAR2(1)</code>	NOT NULL	Whether the group is in a default group

Column	Datatype	Null	Description
ROW_GROUP	VARCHAR2 (1)	NOT NULL	Whether the group is in a label

Related Topics

- [SA_USER_ADMIN.ADD_GROUPS](#)
The `SA_USER_ADMIN.ADD_GROUPS` procedure adds (assigns) groups to a user, indicating if the groups are authorized for write and read privileges.

E.2.30 DBA_SA_USER_LABELS

The `DBA_SA_USER_LABELS` data dictionary view shows for the entire database label-specific information about users.

Its columns are the same as `ALL_SA_USER_LABELS`.

Related Topics

- [ALL_SA_USER_LABELS](#)
The `ALL_SA_USER_LABELS` data dictionary view shows for the current user label-specific information about users, based on the `SA_USER_ADMIN.SET_USER_` procedure settings.

E.2.31 DBA_SA_USER_LEVELS

The `DBA_SA_USER_LEVELS` data dictionary view shows for the entire database the minimum and maximum levels that have been assigned to users.

This view also shows the default values for the user's session label and row label.

Its columns are the same as `ALL_SA_USER_LEVELS`.

Related Topics

- [ALL_SA_USER_LEVELS](#)
The `ALL_SA_USER_LEVELS` data dictionary view shows for the current user the minimum and maximum levels assigned to users, based on the `SA_USER_ADMIN.SET_LEVELS` procedure.

E.2.32 DBA_SA_USER_PRIVS

The `DBA_SA_USER_PRIVS` data dictionary view shows for the current user the policy-specific privileges that have been granted to users.

Its columns are the same as `ALL_SA_USER_PRIVS`.

Related Topics

- [ALL_SA_USER_PRIVS](#)
The `ALL_SA_USER_PRIVS` data dictionary view shows for the current user policy-specific privileges granted to users, based on the `SA_USER_ADMIN.SET_USER_PRIVS` procedure.

E.2.33 DBA_OLS_STATUS

The `DBA_OLS_STATUS` data dictionary view shows the configuration status of Oracle Label Security in the database.

Column	Datatype	Null	Description
NAME	VARCHAR2 (20)	NULL	Name of the status. Values are: <ul style="list-style-type: none"> OLS_CONFIGURE_STATUS OLS_ENABLE_STATUS
STATUS	VARCHAR2 (5)	NULL	Indicates the status of the feature mentioned in the corresponding name column. For example, a TRUE value for the OLS_CONFIGURE_STATUS status says that Oracle Label Security has been configured.
DESCRIPTION	VARCHAR2 (4000)	NULL	Description of the status: <ul style="list-style-type: none"> OLS_CONFIGURE_STATUS: Determines if Oracle Label Security is configured. OLS_ENABLE_STATUS: Determines if Oracle Label Security is enabled.

E.2.34 USER_SA_SESSION

The USER_SA_SESSION data dictionary view shows the security attribute values for the current database session.

Access to this view is PUBLIC.

Column	Datatype	Null	Description
POLICY_NAME	VARCHAR2 (30)	NOT NULL	Name of the Oracle Label Security policy
SA_USER_NAME	VARCHAR2 (4000)	NULL	Name of the current session user
PRIVS	VARCHAR2 (4000)	NULL	Current session privileges
MAX_READ_LABEL	VARCHAR2 (4000)	NULL	Label string that initialized the user's maximum authorized read label
MAX_WRITE_LABEL	VARCHAR2 (4000)	NULL	Label string that initialized the user's maximum authorized write label
MIN_LEVEL	VARCHAR2 (4000)	NULL	Minimum Oracle Label Security level authorized for the session
LABEL	VARCHAR2 (4000)	NULL	Label for the current database session
COMP_WRITE	VARCHAR2 (4000)	NULL	Compartments to which the user is authorized to write
GROUP_WRITE	VARCHAR2 (4000)	NULL	Groups to which the user is authorized to write
ROW_LABEL	VARCHAR2 (4000)	NULL	Row label that is associated with the policy for the current session

E.3 Oracle Label Security User-Created Auditing View

The SA_AUDIT_ADMIN.CREATE_VIEW procedure can be used to create an audit trail view for a specific policy.

By default, this view is named DBA_policyname_AUDIT_TRAIL.

Column	Datatype	Null	Description
USERNAME	VARCHAR2 (128)	NULL	Name of the user whose actions were audited
USERHOST	VARCHAR2 (128)	NULL	Client host machine name
TERMINAL	VARCHAR2 (255)	NULL	Identifier of the user's terminal
TIMESTAMP	DATE	NULL	Date and time of the creation of the audit trail entry (date and time of user login for entries created by <code>AUDIT SESSION</code>) in the local database session time zone
OWNER	VARCHAR2 (128)	NULL	Creator of the object affected by the action
OBJ_NAME	VARCHAR2 (128)	NULL	Name of the object affected by the action
ACTION	NUMBER	NOT NULL	Numeric action type code. The corresponding name of the action type is in the <code>ACTION_NAME</code> column.
ACTION_NAME	VARCHAR2 (47)	NULL	Name of the action type corresponding to the numeric code in the <code>ACTION</code> column
COMMENT_TEXT	VARCHAR2 (4000)	NULL	Text comment on the audit trail entry, providing more information about the statement audited Also indicates how the user was authenticated. The method can be one of the following: <ul style="list-style-type: none"> <code>DATABASE</code>: Authentication was done by password <code>NETWORK</code>: Authentication was done by Oracle Net Services or by strong authentication
SESSIONID	NUMBER	NOT NULL	Numeric ID for each Oracle session
ENTRYID	NUMBER	NOT NULL	Numeric ID for each audit trail entry in the session
STATEMENTID	NUMBER	NOT NULL	Numeric ID for each statement run
RETURNCODE	NUMBER	NOT NULL	Oracle error code generated by the action. Some useful values: <ul style="list-style-type: none"> 0: Action succeeded 2004: Security violation
EXTENDED_TIMESTAMP	TIMESTAMP (6) WITH TIME ZONE	NULL	Timestamp of the creation of the audit trail entry (timestamp of user login for entries created by <code>AUDIT SESSION</code>) in UTC (Coordinated Universal Time) time zone
OLS_COL	VARCHAR2 (4000)	NULL	Name of the column that was added to the tables that Oracle Label Security protects

Related Topics

- [SA_AUDIT_ADMIN.CREATE_VIEW](#)
The `SA_AUDIT_ADMIN.CREATE_VIEW` procedure creates an audit trail view named `DBA_policyname_AUDIT_TRAIL`.

F

Oracle Label Security Restrictions

Several restrictions exist in this Oracle Label Security release.

These restrictions are as follows:

- `CREATE TABLE AS SELECT` restriction

If you attempt to perform `CREATE TABLE AS SELECT` in a schema that is protected by an Oracle Label Security policy, then the statement will fail.

- Label tag restriction

Label tags must be unique across the policies in the database. When you use multiple policies in a database, you cannot use the same numeric label tag in different policies.

- Export restriction

Before Oracle Database 12c release 1 (12.1), the `LBACSYS` schema could not be exported due to the use of opaque types in Oracle Label Security. An export of the entire database (parameter `FULL=Y`) with Oracle Label Security installed can be done, except that the `LBACSYS` schema would not be exported.

From Oracle Database release 12c on, this restriction has been removed. See [Full Database Export](#) for additional details on the database versions that the export can be supported from.

- Oracle Label Security removal restriction

Do not perform a `DROP USER CASCADE` on the `LBACSYS` account.

Connect to the database as user `SYS`, using the `AS SYSDBA` syntax, and run the file `$ORACLE_HOME/rdbms/admin/catnools.sql` to remove Oracle Label Security.

See [Uninstalling Oracle Label Security](#) for information about the different values that you can use to uninstall Oracle Label Security.

- Shared schema support restriction

The Oracle Label Security function `SET_ACCESS_PROFILE` can be used programmatically to set the label authorization profile to use after a user has been authenticated and mapped to a shared schema. Oracle Label Security does not enforce a mapping between users who are given label authorizations in Oracle Label Security and actual database users.

- Hidden columns restriction

PL/SQL does not recognize references to hidden columns in tables. A compiler error will be generated.

- Database objects restriction

Oracle Label Security does not support the following objects:

- External tables
- Blockchain tables
- Immutable tables
- Analytic workspace tables

- Common objects
- Application common objects
- JSON duality views
- Materialized views

G

Frequently Asked Questions about Oracle Label Security

Customers have frequently asked questions about Oracle Label Security.

- [Who Uses Oracle Label Security?](#)
Sensitivity labels can categorize data in virtually every industry.
- [How Can Oracle Label Security Address My Security Needs?](#)
Oracle Label Security can label data and restrict access with a high degree of granularity.
- [Should I Use Oracle Label Security to Protect All My Tables?](#)
No, you should not use Oracle Label Security to protect all of your tables.
- [What Is the Difference Between Oracle Virtual Private Database and Oracle Label Security?](#)
Oracle Virtual Private Database (VPD) is provided at no additional cost with the Enterprise Edition of Oracle Database.
- [Can I Combine Oracle Virtual Private Database and Oracle Label Security?](#)
Yes. You can use a `WHERE` clause or a VPD policy.
- [Can I Use Oracle Label Security with Oracle E-Business Suite?](#)
Oracle Applications use Oracle Virtual Private Database (VPD) to provide new functionality and security protections.
- [Can I Use Oracle Label Security with Oracle Database Vault?](#)
Oracle Database Vault and Oracle Label Security can be used together within the same database.
- [Does Oracle Label Security Provide Column-Level Access Control?](#)
No, Oracle Label Security is not column aware.
- [Can I Base Secure Application Roles on Oracle Label Security?](#)
Yes, you can base secure application roles on Oracle Label Security.
- [What Are Trusted Stored Program Units?](#)
Trusted stored program units are stored procedures, functions, and packages that run with the system and object privileges (DAC) of the definer.
- [Does VPD or OLS Add an Additional Column to the Protected Table?](#)
When you apply an Oracle Label Security (OLS) policy to a table, the policy adds an additional column to the table.
- [Why Should the Additional OLS Row Label Column Be Hidden?](#)
Most applications are designed with access control mechanisms in mind, so Oracle Label Security must do this transparently.

G.1 Who Uses Oracle Label Security?

Sensitivity labels can categorize data in virtually every industry.

These industries include health care, law enforcement, energy, retail, national security, and defense industries.

The following list gives some examples of sensitivity labels:

- Internal
- ConfidentialPhysician OnlyHighly SensitiveWidget CorporationConfidential: Chicago
OperationSensitive: Finance : EuropeTop SecretUnclassified

G.2 How Can Oracle Label Security Address My Security Needs?

Oracle Label Security can label data and restrict access with a high degree of granularity.

This is especially useful when multiple organizations or companies share a single application. Sensitivity labels can be used to restrict application users to an organization or to a subset of data within an organization.

Data privacy is important to consumers and regulatory measures continue to be announced. Oracle Label Security can be used to implement privacy policies on data, restricting access to only those who have a need-to-know.

G.3 Should I Use Oracle Label Security to Protect All My Tables?

No, you should not use Oracle Label Security to protect all of your tables.

The traditional Oracle discretionary access control (DAC) object privileges such as `SELECT`, `INSERT`, `UPDATE`, and `DELETE` combined with database roles and stored procedures are sufficient in most cases. You can find a user's privileges by querying the `DBA_SYS_PRIVS` data dictionary view.

In addition, there are many other ways that you can protect access to your database tables, such using Oracle Virtual Private Database (VPD), Oracle Database Vault, Oracle Data Redaction, Transparent Data Encryption (TDE), or Transparent Sensitive Data Protection (TSDP).

G.4 What Is the Difference Between Oracle Virtual Private Database and Oracle Label Security?

Oracle Virtual Private Database (VPD) is provided at no additional cost with the Enterprise Edition of Oracle Database.

Oracle Label Security is an add-on security option for the Oracle Database Enterprise Edition.

Oracle VPD is a term used for several powerful security features like, fine grained access control (FGAC), application context and global application context. VPD policies are written using `PL/SQL`, and can be assigned to an individual table or view. An information request, that accesses a table or view protected by VPD, is modified according to the policy assigned to the table or view.

VPD policies can be as simple as enforcing access during business hours. VPD policies can restrict access by comparing the value of an attribute in an individual row with an application context value. Global application context allows an application context to be accessed across multiple database sessions, reducing or eliminating the need to create a separate application context for each user session.

Oracle Label Security is an out-of-the-box solution for row level security. No coding or software development is required, allowing the administrator to focus completely on the policy. Oracle Label Security provides an interface for creating policies, specifying enforcement options, defining data sensitivity labels, establishing user label authorizations, and protecting individual tables or schemes.

Data sensitivity labels provide a powerful and flexible method of restricting access to data. For example, data belonging to different organizations or companies can be separated using data sensitivity labels and selectively shared between companies by changing the data sensitivity label.

Depending on the complexity of the security policy, Oracle Virtual Private Database may be the preferred method for implementing your security policy. Oracle Label Security is best suited for situations where access control decisions need to be based on the sensitivity of the information.

G.5 Can I Combine Oracle Virtual Private Database and Oracle Label Security?

Yes. You can use a `WHERE` clause or a VPD policy.

- A `WHERE` clause can be appended to an OLS policy, which provides one more level of granularity. An example would be that users, regardless of their label authorizations, are only allowed to connect from a specific IP address or subnet, and during business hours only.
- A VPD policy, whether column sensitive or not, can evaluate user labels and determine access to columns and rows without the need to apply data labels.

G.6 Can I Use Oracle Label Security with Oracle E-Business Suite?

Oracle Applications use Oracle Virtual Private Database (VPD) to provide new functionality and security protections.

In addition, you can use other Oracle security products with Oracle E-Business Suite, such as Oracle Database Vault. Contact Oracle Support for more information.

G.7 Can I Use Oracle Label Security with Oracle Database Vault?

Oracle Database Vault and Oracle Label Security can be used together within the same database.

An Oracle Database Vault realm can protect a table that is also protected by an Oracle Label Security policy. The realm can protect the entire table and the Oracle Label Security can provide row level security for users that need to access the table data.

In addition, Oracle Label Security can be used together with Database Vault features. You can assign Oracle Label Security labels to Database Vault Factors. These labels are then merged with the user clearance labels, following the algorithms documented in [Merging Labels with the MERGE_LABEL Function](#), before access control decisions are being made by comparing the merged user labels with the row labels.

The following example on the Oracle Technology Network Web site discusses using Oracle Label security along with Oracle Database Vault features:

<http://www.oracle.com/technetwork/database/security/label-security-factors-093209.html>

G.8 Does Oracle Label Security Provide Column-Level Access Control?

No, Oracle Label Security is not column aware.

This behavior is available with Virtual Private Database (VPD). A VPD policy can be written so that it only becomes active when a certain column is part of a SQL statement against a protected table. If the *column sensitivity* switch is on, then VPD either returns only those rows for which the sensitive column values are accessible to the user, or it returns all rows with all cells in the sensitive column being empty, except those values that the user is allowed to see.

The following link on the Oracle Technology Network Web site contains an example:

<http://www.oracle.com/technetwork/database/security/index-088277.html>

A column-sensitive VPD policy can determine access to a specific column by evaluating OLS user labels, which this example demonstrates:

<http://www.oracle.com/technetwork/database/security/ols-cs1-099558.html>

G.9 Can I Base Secure Application Roles on Oracle Label Security?

Yes, you can base secure application roles on Oracle Label Security.

The procedure that determines if the `SET ROLE` command is run can evaluate OLS user labels. In this case, the OLS policy does not need to be applied to a table, since row labels are not part of this solution.

G.10 What Are Trusted Stored Program Units?

Trusted stored program units are stored procedures, functions, and packages that run with the system and object privileges (DAC) of the definer.

If the invoker is a user with Oracle Label Security user clearances (labels), the procedure runs with a combination of the definer's DAC privileges and the invoker's security clearances.

Trusted stored procedures are procedures that are either granted the Oracle Label Security privilege `FULL` or `READ`. When a trusted stored program unit is run, the policy privileges in force are a combination of the invoking user's privileges and the program unit's privileges.

G.11 Does VPD or OLS Add an Additional Column to the Protected Table?

When you apply an Oracle Label Security (OLS) policy to a table, the policy adds an additional column to the table.

The name of this column needs to be specified when the policy is initially created.

An existing column can be used to store the OLS row labels. This column must have the `NUMBER(10)` data type.

Oracle Virtual Private Database (VPD) does not add an additional column to the protected table.

G.12 Why Should the Additional OLS Row Label Column Be Hidden?

Most applications are designed with access control mechanisms in mind, so Oracle Label Security must do this transparently.

When an application queries a table with a `SELECT FROM tablename` statement, it returns all columns, including the unhidden label column. Existing applications may not be designed to display an additional column, and malfunction. However, if the label column is hidden, then it is displayed only when its name is included in the SQL statement. A `SELECT FROM tablename` would return all columns as expected by the application, excluding the hidden OLS column.

H

Troubleshooting Oracle Label Security

Oracle provides guidance for troubleshooting Oracle Label Security tasks.

- [Invalid SYS.OLS_ENFORCEMENT and SYS.LBAC_EXP Packages](#)
If the `SYS.OLS_ENFORCEMENT` and `SYS.LBAC_EXP` PL/SQL packages are invalid, then Oracle Label Security may not have been installed correctly.
- [Addressing ORA-6550 and ORA-942 Errors](#)
The `ORA-6550` and `ORA-942` errors indicate that the Oracle Label Security component of the Oracle Database upgrade is invalid.

H.1 Invalid SYS.OLS_ENFORCEMENT and SYS.LBAC_EXP Packages

If the `SYS.OLS_ENFORCEMENT` and `SYS.LBAC_EXP` PL/SQL packages are invalid, then Oracle Label Security may not have been installed correctly.

To remedy this problem, you must validate the `SYS.OLS_ENFORCEMENT` and `SYS.LBAC_EXP` package objects.

1. Log into the PDB as a user who has the `SYSDBA` administrative privilege.

To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.

2. Run the following command to validate the two packages.

```
@?/rdbms/admin/catols.sql
```

3. Run the following commands:

```
EXEC LBACSYS.CONFIGURE_OLS  
EXEC LBACSYS.OLS_ENFORCEMENT.ENABLE_OLS
```

4. Restart the database instance.
5. Check the `INVALID` objects to see if the above two items are still listed.
6. If Oracle Label Security must be disabled after you validate these objects, then do the following:

- a. Disable Oracle Label Security.

```
EXEC LBACSYS.OLS_ENFORCEMENT.DISABLE_OLS;
```

- b. Restart the database.

H.2 Addressing ORA-6550 and ORA-942 Errors

The ORA-6550 and ORA-942 errors indicate that the Oracle Label Security component of the Oracle Database upgrade is invalid.

The errors occur during the execution of the `catuppst.sql` script. The following errors are encountered:

```
catuppst.sql unable to run in Database: XXXX Id: 0
ERRORS FOUND: during upgrade CATCTL ERROR COUNT=5
-----
Identifier OLS 23-01-10 01:44:51 Script =
/release/orabase/oracle/rdbms/admin/ols
ERROR = [ORA-06550: line 119, column 41: PL/SQL: ORA-00942: table or view
does not exist
ORA-06550: line 118, column 5:
PL/SQL: SQL Statement ignored
```

1. Log into the PDB as a user who has the SYSDBA administrative privilege.

To find the available PDBs, query the `DBA_PDBS` data dictionary view. To check the current PDB, run the `show con_name` command.

2. Disable and then reenables Oracle Label Security.
3. Recompile the objects.

```
@$ORACLE_HOME/rdbms/admin/utlsp.sql
```

4. Run the following procedure to validate Oracle Label Security:

```
EXECUTE SYS.VALIDATE_OLS;
```

5. If `utlsp.sql` compiles all the Oracle Label Security (LDAPSYS) objects successfully, and there are no errors during compilation, then run the following procedure:

```
EXEC DBMS_REGISTRY.VALID('OLS');
```

Related Topics

- [Disabling and Enabling Oracle Label Security](#)
You can disable and enable Oracle Label Security as necessary.

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