5

Performing Privilege Analysis to Identify Privilege Use

Privilege analysis dynamically analyzes the privileges and roles that users use and do not use.

- What Is Privilege Analysis?
  Privilege analysis increases the security of your applications and database operations by helping you to implement least privilege best practices for database roles and privileges.
- Creating and Managing Privilege Analysis Policies
  You can create and manage privilege analysis policies by using tools such as SQL*Plus, SQLcl, SQL Developer, or Enterprise Manager Cloud Control.
- Creating Roles and Managing Privileges Using Cloud Control
  You can create new roles using privileges found in a privilege analysis report and then grant this role to users.
- Tutorial: Using Capture Runs to Analyze ANY Privilege Use
  This tutorial demonstrates how to create capture runs to analyze the use of the `READ ANY TABLE` system privilege.
- Tutorial: Analyzing Privilege Use by a User Who Has the DBA Role
  This tutorial demonstrates how to analyze the privilege use of a user who has the `DBA` role and performs database tuning operations.
- Tutorial: Capturing Schema Privilege Use
  This tutorial shows how to capture a user's schema privilege use for the `SELECT ANY TABLE` and `DELETE ANY TABLE` system privileges on the `HR` schema.
- Privilege Analysis Policy and Report Data Dictionary Views
  Oracle Database provides a set of data dictionary views that provide information about analyzed privileges.

5.1 What Is Privilege Analysis?

Privilege analysis increases the security of your applications and database operations by helping you to implement least privilege best practices for database roles and privileges.

- About Privilege Analysis
  Running inside the Oracle Database kernel, privilege analysis helps reduce the attack surface of user, tooling, and application accounts by identifying used and unused privileges to implement the least-privilege model.
- Benefits and Use Cases of Privilege Analysis
  Analyzing privilege use is beneficial in finding unnecessarily granted privileges and implementing least privilege best practices.
- Who Can Perform Privilege Analysis?
  To use privilege analysis, you must be granted the `CAPTURE_ADMIN` role.
- Types of Privilege Analysis
  You can create different types of privilege analysis policies to achieve specific goals.

- How Does a Multitenant Environment Affect Privilege Analysis?
  You can create and use privilege analysis policies in a multitenant environment.
- How Privilege Analysis Works with Pre-Compiled Database Objects
  Privilege analysis can be used to capture the privileges that have been exercised on pre-compiled database objects.

5.1.1 About Privilege Analysis

Running inside the Oracle Database kernel, privilege analysis helps reduce the attack surface of user, tooling, and application accounts by identifying used and unused privileges to implement the least-privilege model.

Privilege analysis dynamically captures privileges used by database users and applications during a specified window of time. It lists the used and unused privileges in reports that can be queried from data dictionary views.

The use of privilege analysis can help to quickly and efficiently enforce least privilege guidelines. In the least-privilege model, users are only given the privileges and access they need to do their jobs. Frequently, even though users perform different tasks, users are all granted the same set of powerful privileges. Without privilege analysis, figuring out the privileges that each user must have can be hard work and in many cases, users could end up with some common set of privileges even though they have different tasks. Even in organizations that manage privileges, users tend to accumulate privileges over time and rarely lose any privileges. Separation of duty breaks a single process into separate tasks for different users. Least privileges enforces the separation so users can only do their required tasks. The enforcement of separation of duty is beneficial for internal control, and it also reduces the risk from malicious users who steal privileged credentials.

Privilege analysis captures privileges used by database users and applications at runtime and writes its findings to data dictionary views that you can query. If your applications include definer’s rights and invoker’s rights procedures, then privilege analysis captures the privileges that are required to compile a procedure and run it, even if the procedure was compiled before the privilege capture was created and enabled. Instead of revoking a privilege from the user, you can audit the user's use of the privilege and use an application such as Oracle Audit Vault and Database Firewall to send an alert to the appropriate administrator.

5.1.2 Benefits and Use Cases of Privilege Analysis

Analyzing privilege use is beneficial in finding unnecessarily granted privileges and implementing least privilege best practices.

- Least Privileges Best Practice
  The privileges of the account that accesses a database should be limited to the privileges that are strictly required by the application or the user.
- Development of Secure Applications
  During the application development phase, some administrators may grant many powerful system privileges and roles, and the `SYSDBA` administrative privilege, to application developers.

5.1.2.1 Least Privileges Best Practice

The privileges of the account that accesses a database should be limited to the privileges that are strictly required by the application or the user.

But when an application is developed, especially by a third party, more privileges than necessary may be granted to the application connection pool accounts for convenience. In addition, some developers grant system and application object privileges to the `PUBLIC` role.

For example, to select from application data and run application procedures, the system privileges `SELECT ANY TABLE` and `EXECUTE ANY PROCEDURE` are granted to an application account `appsys`. The account `appsys` now can access non-application data even if they do not intend to. In this situation, you can analyze the privilege usage by user `appsys`, and then based on the results, revoke and grant privileges as necessary.

Application accounts also frequently have additional privileges needed to install and maintain the application on the database. These are only needed during application maintenance periods, but yet are available all the time. A better process would be to add the privileges needed for application maintenance into a separate role and grant that to the application only during maintenance periods.

5.1.2.2 Development of Secure Applications

During the application development phase, some administrators may grant many powerful system privileges and roles, and the `SYSDBA` administrative privilege, to application developers.

The administrators may do this because at that stage they may not know what privileges the application developer needs or is not concerned with privileges and roles during development.

Once the application is developed and working, the privileges that the application developer needs — and does not need — become more apparent. Capturing privilege analysis while the application is run through a full regression test can capture most, if not all the privileges needed by the application for runtime use. Capturing privilege analysis when testing a maintenance update can provide the privileges needed during an update of the production system. At that time, the security administrator can begin to revoke unnecessary privileges. However, the application developer may resist this idea on the basis that the application is currently working without problems. The administrator can use privilege analysis to examine each privilege that the application uses, to ensure that when they do revoke any privileges, the application will continue to work.

For example, `app_owner` is an application database user through whom the application connects to a database. User `app_owner` must query tables in the `OE`, `SH`, and `PM` schemas. Instead of granting the `SELECT` object privilege on each of the tables in these schemas, a security administrator grants the `SELECT ANY TABLE` privilege to `app_owner`. After a while, a new schema, `HR`, is created and sensitive data are inserted into `HR.EMPLOYEES` table. Because user `app_owner` has the `SELECT ANY TABLE` privilege, `app_owner` can query this table to access its sensitive data, which is a security issue. Instead of granting system privileges (particularly the `ANY` privileges), it is far better to grant schema or object privileges for specific tables.

5.1.3 Who Can Perform Privilege Analysis?

To use privilege analysis, you must be granted the `CAPTURE_ADMIN` role.

You use the `DBMS_PRIVILEGE_CAPTURE` PL/SQL package to manage privilege capture. You query the data dictionary views provided by privilege analysis to analyze your privilege use.

5.1.4 Types of Privilege Analysis

You can create different types of privilege analysis policies to achieve specific goals.

- **Context-based privilege use capture.** You must specify a Boolean expression only with the `SYS_CONTEXT` function. The used privileges will be captured if the condition evaluates to `TRUE`. This method can be used to capture privileges and roles used by a database user by specifying the user in `SYS_CONTEXT`.
- **Role-based privilege use capture.** You must provide a list of roles. If the roles in the list are enabled in the database session, then the used privileges for the session will be captured. You can capture privilege use for the following types of roles: Oracle default roles, user-created roles, Code Based Access Control (CBAC) roles, and secure application roles.
- **Role- and context-based privilege use capture.** You must provide both a list of roles that are enabled and a `SYS_CONTEXT` Boolean expression for the condition. When any of these roles is enabled in a session and the given context condition is satisfied, then privilege analysis starts capturing the privilege use.
- **Database-wide privilege capture.** If you do not specify any type in your privilege analysis policy, then the used privileges (including schema privileges) in the database will be captured, except those for the user `SYS`. (This is also referred to as unconditional analysis, because it is turned on without any conditions.)

Note the following restrictions:

- You can enable only one privilege analysis policy at a time. The only exception is that you can enable a database-wide privilege analysis policy at the same time as a non-database-wide privilege analysis policy, such as a role or context attribute-driven analysis policy.
- You cannot analyze the privileges of the `SYS` user.
- Privilege analysis shows the grant paths to the privilege but it does not suggest which grant path to keep.
- If the role, user, or object has been dropped, then the values that reflect the privilege captures for these in the privilege analysis data dictionary views are dropped as well.

5.1.5 How Does a Multitenant Environment Affect Privilege Analysis?

You can create and use privilege analysis policies in a multitenant environment.

You can create privilege analysis policies in either the CDB root or in individual PDBs. An example use case is when a site has human infrastructure database administrators who use common user accounts. The privilege analysis policy applies only to the container in which it is created, either to the privileges used within the CDB root or the application root, or to the privileges used within a PDB. It cannot be applied globally throughout the multitenant environment. You can grant the `CAPTURE_ADMIN` role locally to a local user or a common user. You can grant the `CAPTURE_ADMIN` role commonly to common users.

5.1.6 How Privilege Analysis Works with Pre-Compiled Database Objects

Privilege analysis can be used to capture the privileges that have been exercised on pre-compiled database objects.

Examples of these objects are PL/SQL packages, procedures, functions, views, triggers, and Java classes and data.

Because these privileges may not be exercised during run time when a stored procedure is called, these privileges are collected when you generate the results for any database-wide capture, along with run-time captured privileges. A privilege is treated as an unused privilege when it is not used in either pre-compiled database objects or run-time capture, and it is saved under the run-time capture name. If a privilege is used for pre-compiled database objects, then it is saved under the capture name `ORA$DEPENDENCY`. If a privilege is captured during run time, then it is saved under the run-time capture name. If you want to know what the used privileges are for both pre-compiled database objects and run-time usage, then you must query both the `ORA$DEPENDENCY` and run-time captures. For unused privileges, you only need to query with the run-time capture name.

To find a full list of the pre-compiled objects on which privilege analysis can be used, query the `TYPE` column of the `ALL_DEPENDENCIES` data dictionary view.

5.2 Creating and Managing Privilege Analysis Policies

You can create and manage privilege analysis policies by using tools such as SQL*Plus, SQLcl, SQL Developer, or Enterprise Manager Cloud Control.

- About Creating and Managing Privilege Analysis Policies
  You can use the `DBMS_PRIVILEGE_CAPTURE` PL/SQL package or Oracle Enterprise Manager Cloud Control to analyze privileges.
- General Steps for Managing Privilege Analysis
  You must follow a general set of steps to analyze privileges.
- Creating a Privilege Analysis Policy
  You can use the `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` procedure to create a privilege analysis policy.
- Examples of Creating Privilege Analysis Policies
  You can create a variety of privilege analysis policies.
- Enabling a Privilege Analysis Policy
  After you create a privilege analysis policy, you must enable it to capture privilege use.
- Disabling a Privilege Analysis Policy
  You must disable the privilege analysis policy before you can generate a privilege analysis report.
- Generating a Privilege Analysis Report
  You can generate a privilege analysis policy report using either Enterprise Manager Cloud Control or from SQL*Plus, using the `DBMS_PRIVILEGE_CAPTURE` PL/SQL package.
- Dropping a Privilege Analysis Policy
  Before you can drop a privilege analysis policy, you must first disable it.

5.2.1 About Creating and Managing Privilege Analysis Policies

You can use the `DBMS_PRIVILEGE_CAPTURE` PL/SQL package or Oracle Enterprise Manager Cloud Control to analyze privileges.

Before you can do so, you must be granted the `CAPTURE_ADMIN` role. The `DBMS_PRIVILEGE_CAPTURE` package enables you to create, enable, disable, and drop privilege analysis policies. It also generates reports that show the privilege usage, which you can view in `DBA_*` views.

Related Topics

- *Oracle Database PL/SQL Packages and Types Reference*

5.2.2 General Steps for Managing Privilege Analysis

You must follow a general set of steps to analyze privileges.

1. Define the privilege analysis policy.
2. Enable the privilege analysis policy.

   This step begins recording the privilege use that the policy defined. Optionally, specify a name for this capture run. Each time you enable a privilege analysis policy, you can create a different capture run for it. In this way, you can create multiple named capture runs for comparison analysis later on.
3. Optionally, enable the policy to capture dependency privileges if you want to capture the privileges that are used by definer's rights and invoker's rights program units.
4. After a sufficient period of time to gather data, disable the privilege analysis policy's recording of privilege use.

   This step stops capturing the privilege use for the policy.
5. Generate privilege analysis results.

   This step writes the results to the privilege analysis policy and report data dictionary views.
6. Optionally, disable and then drop the privilege analysis policy and capture run.

   Dropping a privilege analysis policy deletes the data captured by the policy.

Related Topics

- Privilege Analysis Policy and Report Data Dictionary Views
  Oracle Database provides a set of data dictionary views that provide information about analyzed privileges.

5.2.3 Creating a Privilege Analysis Policy

You can use the `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` procedure to create a privilege analysis policy.

After you create the privilege analysis policy, you can find it listed in the `DBA_PRIV_CAPTURES` data dictionary view. When a policy is created, it resides in the `SYS` schema. However, both `SYS` and the user who created the policy can drop it. After you create the policy, you must manually enable it so that it can begin to analyze privilege use.

1. Log in to the CDB or PDB as a user who has the `CAPTURE_ADMIN` role.
   To find the available PDBs in a CDB, log in to the CDB root container and then query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.
2. Use the following syntax for the `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` procedure:

   ```
   DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
      name              VARCHAR2,
      description       VARCHAR2 DEFAULT NULL,
      type              NUMBER DEFAULT DBMS_PRIVILEGE_CAPTURE.G_DATABASE,
      roles             ROLE_NAME_LIST DEFAULT ROLE_NAME_LIST(),
      condition         VARCHAR2 DEFAULT NULL);
   ```

   In this specification:

- `name`: Specifies the name of the privilege analysis policy to be created. Ensure that this name is unique and no more than 128 characters. You can include spaces in the name, but you must enclose the name in single quotation marks whenever you refer to it. To find the names of existing policies, query the `NAME` column of the `DBA_PRIV_CAPTURES` view.
- `description`: Describes the purpose of the privilege analysis policy, up to 1024 characters in mixed-case letters. Optional.
- `type`: Specifies the type of capture condition. If you omit the `type` parameter, then the default is `DBMS_PRIVILEGE_CAPTURE.G_DATABASE`. Optional.

  Enter one of the following types:

  – `DBMS_PRIVILEGE_CAPTURE.G_DATABASE`: Captures all privileges used in the entire database, except privileges from user `SYS`.

  – `DBMS_PRIVILEGE_CAPTURE.G_ROLE`: Captures privileges for the sessions that have the roles enabled. If you enter `DBMS_PRIVILEGE_CAPTURE.G_ROLE` for the `type` parameter, then you must also specify the `roles` parameter. For multiple roles, separate each role name with a comma.

  – `DBMS_PRIVILEGE_CAPTURE.G_CONTEXT`: Captures privileges for the sessions that have the condition specified by the `condition` parameter evaluating to `TRUE`. If you enter `DBMS_PRIVILEGE_CAPTURE.G_CONTEXT` for the `type` parameter, then you must also specify the `condition` parameter.

  – `DBMS_PRIVILEGE_CAPTURE.G_ROLE_AND_CONTEXT`: Captures privileges for the sessions that have the role enabled and the context condition evaluating to `TRUE`. If you enter `DBMS_PRIVILEGE_CAPTURE.G_ROLE_AND_CONTEXT` for the `type` parameter, then you must also specify both the `roles` and `condition` parameters.
- `roles`: Specifies the roles whose used privileges will be analyzed. That is, if a privilege from one of the given roles is used, then the privilege will be analyzed. You must specify this argument if you specify `DBMS_PRIVILEGE_CAPTURE.G_ROLE` or `DBMS_PRIVILEGE_CAPTURE.G_ROLE_AND_CONTEXT` for the `type` argument. Each role you enter must exist in the database. (You can find existing roles by querying the `DBA_ROLES` data dictionary view.) For multiple roles, use varray type `role_name_list` to enter the role names. You can specify up to 10 roles.

  For example, to specify two roles:

  ```
  roles => role_name_list('role1', 'role2'),
  ```
- `condition`: Specifies a Boolean expression up to 4000 characters. You must specify this argument if you specify `DBMS_PRIVILEGE_CAPTURE.G_CONTEXT` or `DBMS_PRIVILEGE_CAPTURE.G_ROLE_AND_CONTEXT` for the `type` argument. Only `SYS_CONTEXT` expressions with relational operators(==, >, >=, <, <=, <>, `BETWEEN`, and `IN`) are permitted in this Boolean expression.

  The `condition` expression syntax is as follows:

  ```
  predicate::= SYS_CONTEXT(namespace, attribute) relop constant_value |
               SYS_CONTEXT(namespace, attribute)
               BETWEEN
               constant_value
               AND constant_value | SYS_CONTEXT(namespace, attribute)
               IN {constant_value (,constant_value)* }

  relop::= = | < | <= | > | >= | <>

  context_expression::= predicate | (context_expression)
  ```

```
AND (context_expression) | (context_expression)
OR (context_expression )
```

For example, to use a condition to specify the IP address `192.0.2.1`:

```
condition => 'SYS_CONTEXT(''USERENV'', ''IP_ADDRESS'')=''192.0.2.1''';
```

After you create the privilege analysis policy, you must enable the policy to begin capturing privilege and role use.

* You can add as many constant values as you need (for example, `IN {`*`constant_value1`*`}`, or `IN {`*`constant_value1`*`, `*`constant_value2`*`, `*`constant_value3`*`}`).

Related Topics

- Enabling a Privilege Analysis Policy
  After you create a privilege analysis policy, you must enable it to capture privilege use.

5.2.4 Examples of Creating Privilege Analysis Policies

You can create a variety of privilege analysis policies.

- Example: Privilege Analysis of Database-Wide Privileges
  The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` can be used to analyze database-wide privileges.
- Example: Privilege Analysis of Privilege Usage of Two Roles
  The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` procedure can be used to analyze the privilege usage of multiple roles.
- Example: Privilege Analysis of Privileges During SQL*Plus Use
  The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` procedure can be used to capture privileges for analysis.
- Example: Privilege Analysis of PSMITH Privileges During SQL*Plus Access
  The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` can be used to analyze user access when the user is running SQL*Plus.

5.2.4.1 Example: Privilege Analysis of Database-Wide Privileges

The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` can be used to analyze database-wide privileges.

Example 5-1 shows how to use the `DBMS_PRIVILEGE_CAPTURE` package to create a privilege analysis policy to record all privilege use in the database.

Example 5-1   Privilege Analysis of Database-Wide Privileges

```
BEGIN
 DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
  name          => 'db_wide_capture_pol',
  description   => 'Captures database-wide privileges',
  type          => DBMS_PRIVILEGE_CAPTURE.G_DATABASE);
END;
/
```

5.2.4.2 Example: Privilege Analysis of Privilege Usage of Two Roles

The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` procedure can be used to analyze the privilege usage of multiple roles.

Example 5-2 shows how to analyze the privilege usage of two roles.

Example 5-2   Privilege Analysis of Privilege Usage of Two Roles

```
BEGIN
 DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
  name          => 'dba_roles_capture_pol',
  description   => 'Captures DBA and LBAC_DBA role use',
  type          => DBMS_PRIVILEGE_CAPTURE.G_ROLE,
  roles         => role_name_list('dba', 'lbac_dba'));
END;
/
```

5.2.4.3 Example: Privilege Analysis of Privileges During SQL*Plus Use

The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` procedure can be used to capture privileges for analysis.

Example 5-3 shows how to analyze privileges used to run SQL*Plus.

Example 5-3   Privilege Analysis of Privileges During SQL*Plus Use

```
BEGIN
 DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
  name             => 'sqlplus_capture_pol',
  description      => 'Captures privilege use during SQL*Plus use',
  type             => DBMS_PRIVILEGE_CAPTURE.G_CONTEXT,
  condition        => 'SYS_CONTEXT(''USERENV'', ''MODULE'')=''sqlplus''');
END;
/
```

5.2.4.4 Example: Privilege Analysis of PSMITH Privileges During SQL*Plus Access

The `DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE` can be used to analyze user access when the user is running SQL*Plus.

Example 5-4 shows how to analyze the privileges used by session user `PSMITH` when running SQL*Plus.

Example 5-4   Privilege Analysis of PSMITH Privileges During SQL*Plus Access

```
BEGIN
 DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
  name         => 'psmith_sqlplus_analysis_pol',
  description  => 'Analyzes PSMITH role priv use for SQL*Plus module',
  type         => DBMS_PRIVILEGE_CAPTURE.G_CONTEXT,
  condition    => 'SYS_CONTEXT(''USERENV'', ''MODULE'')=''sqlplus''
                  AND SYS_CONTEXT(''USERENV'', ''SESSION_USER'')=''PSMITH''');
END;
/
```

5.2.5 Enabling a Privilege Analysis Policy

After you create a privilege analysis policy, you must enable it to capture privilege use.

The `DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE` procedure enables a privilege policy and creates a capture run name for it. The run name defines the period of time that the capture took place.

1. Log in to the CDB or PDB as a user who has the `CAPTURE_ADMIN` role.

To find the available PDBs in a CDB, log in to the CDB root container and then query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.

2. Query the `NAME` and `ENABLED` columns of the `DBA_PRIV_CAPTURES` data dictionary view to find the existing privilege analysis policies and whether they are currently enabled.
3. Run the `DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE` procedure to enable the policy and optionally create a name for a capture run.

   For example, to enable the privilege analysis policy `logon_users_analysis`:

```
BEGIN
  DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE (
    name     => 'logon_users_analysis_pol',
    run_name => 'logon_users_04092016');
END;
/
```

   If you do not need to specify the `run_name` parameter, then you can enable the policy by only specifying its name, as follows:

```
EXEC DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE ('logon_users_analysis_pol');
```

5.2.6 Disabling a Privilege Analysis Policy

You must disable the privilege analysis policy before you can generate a privilege analysis report.

After you disable the policy, then the privileges are no longer recorded. Disabling a privilege analysis policy takes effect immediately for user sessions logged on both before and after the privilege analysis policy is disabled. You can use the `DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE` procedure to disable a privilege analysis policy.

1. Log in to the CDB or PDB as a user who has the `CAPTURE_ADMIN` role.

   To find the available PDBs in a CDB, log in to the CDB root container and then query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.
2. Query the `NAME` and `ENABLED` columns of the `DBA_PRIV_CAPTURES` data dictionary view to find the existing privilege analysis policies and whether they are currently disabled.
3. Run the `DBMS_PRIVILEGE_CAPTURE.DISBLE_CAPTURE` procedure to enable the policy.

   For example, to disable the privilege analysis policy `logon_users_analysis`:

```
EXEC DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE ('logon_users_analysis_pol');
```

5.2.7 Generating a Privilege Analysis Report

You can generate a privilege analysis policy report using either Enterprise Manager Cloud Control or from SQL*Plus, using the `DBMS_PRIVILEGE_CAPTURE` PL/SQL package.

- About Generating a Privilege Analysis Report
  After the privilege analysis policy has been disabled, you can generate a report based on the capture run that you created for the privilege analysis policy.
- General Process for Managing Multiple Named Capture Runs
  When you enable a privilege analysis policy, you can create a named capture run for the policy's findings.

- Generating a Privilege Analysis Report Using DBMS_PRIVILEGE_CAPTURE
  The `DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT` procedure generates a report showing the results of a privilege capture.
- Generating a Privilege Analysis Report Using Cloud Control
  You can generate a privilege analysis report using Cloud Control.
- Accessing Privilege Analysis Reports Using Cloud Control
  A privilege analysis report provides information about both used and unused privileges.

5.2.7.1 About Generating a Privilege Analysis Report

After the privilege analysis policy has been disabled, you can generate a report based on the capture run that you created for the privilege analysis policy.

To view the report results in SQL*Plus, query the privilege analysis-specific data dictionary views. In Enterprise Manager Cloud Control, you can view the reports from the Privilege Analysis page **Actions** menu. If a privilege is used during the privilege analysis process and then revoked before you generate the report, then the privilege is still reported as a used privilege, but without the privilege grant path.

Related Topics

- Privilege Analysis Policy and Report Data Dictionary Views
  Oracle Database provides a set of data dictionary views that provide information about analyzed privileges.

5.2.7.2 General Process for Managing Multiple Named Capture Runs

When you enable a privilege analysis policy, you can create a named capture run for the policy’s findings.

The capture run defines a period of time from when the capture is enabled (begun) and when it is disabled (stopped). This way, you can create multiple runs and then compare them when you generate the privilege capture results.

The general process for managing multiple named capture runs is as follows:

1. Create the policy.
2. Enable the policy for the first run.
3. After a period time to collect user behavior data, disable this policy and its run.
4. Generate the results and then query the privilege analysis data dictionary views for information about this capture run.

   If you omit the `run_name` parameter from the `DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT` procedure, then this procedure looks at all records as a whole and then analyzes them.
5. Re-enable the policy for the second run. You cannot create a new capture run if the policy has not been disabled first.
6. After you have collected the user data, disable the policy and the second run.
7. Generate the results.
8. Query the privilege analysis data dictionary views. The results from both capture runs are available in the views. If you only want to show the results of one of the capture runs, then you can regenerate the results and requery the privilege analysis views. You can also filter the results on the run name.

Once enabled, the privilege analysis policy will begin to record the privilege usage when the condition is satisfied. At any given time, only one privilege analysis policy in the database can be enabled. The only exception is that a privilege analysis policy of type `DBMS_PRIVILEGE_CAPTURE.G_DATABASE` can be enabled at the same time with a privilege analysis of a different type.

When you drop a privilege analysis policy, its associated capture runs are dropped as well and are not reflected in the privilege analysis data dictionary views.

Restarting a database does not change the status of a privilege analysis. For example, if a privilege analysis policy is enabled before a database shutdown, then the policy is still enabled after the database shutdown and restart.

Related Topics

- Tutorial: Using Capture Runs to Analyze ANY Privilege Use
  This tutorial demonstrates how to create capture runs to analyze the use of the `READ ANY TABLE` system privilege.

5.2.7.3 Generating a Privilege Analysis Report Using DBMS_PRIVILEGE_CAPTURE

The `DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT` procedure generates a report showing the results of a privilege capture.

1. Log in to the CDB or PDB as a user who has the `CAPTURE_ADMIN` role.

   To find the available PDBs in a CDB, log in to the CDB root container and then query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.

2. Query the `NAME` and `ENABLED` columns of the `DBA_PRIV_CAPTURES` data dictionary view to find the existing privilege analysis policies and whether they are currently disabled.

   The privilege analysis policy must be disabled before you can generate a privilege analysis report on it.

3. Run the `DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT` procedure using the following syntax:

   ```
   DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT(
     name         VARCHAR2,
     run_name     VARCHAR2 DEFAULT NULL,
     dependency   BOOLEAN DEFAULT NULL);
   ```

   In this specification:

   - `name`: Specifies the name of the privilege analysis policy. The `DBA_PRIV_CAPTURES` data dictionary view lists the names of existing policies.
   - `run_name`: Specifies the name for the run name for the privilege capture that must be computed. If you omit this setting, then all runs for the given privilege capture are computed.
   - `dependency`: Enter `Y` (yes) or `N` (no) to specify whether the PL/SQL computation privilege usage should be included in the report.

   For example, to generate a report for the privilege analysis policy `logon_users_analysis`:

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT ('logon_users_analysis');
   ```

4. Query the used privileges from `DBA_USED_*` data dictionary views with privilege grant paths.

5.2.7.4 Generating a Privilege Analysis Report Using Cloud Control

You can generate a privilege analysis report using Cloud Control.

1. Log in to Cloud Control as a user who has been granted the `CAPTURE_ADMIN` role and the `SELECT ANY DICTIONARY` privilege.
2. From the **Security** menu, select **Privilege Analysis**.
3. Under Policies, select the policy whose report you want to generate.
4. Select **Generate Report**.
5. In the Privilege Analysis: Generate Report dialog box, specify a time to generate the report.

   To generate the report now, select **Immediate**. To generate the report later, select **Later**, and then specify the hour, minute, second, and the time zone for the report to generate.
6. Click **OK**.

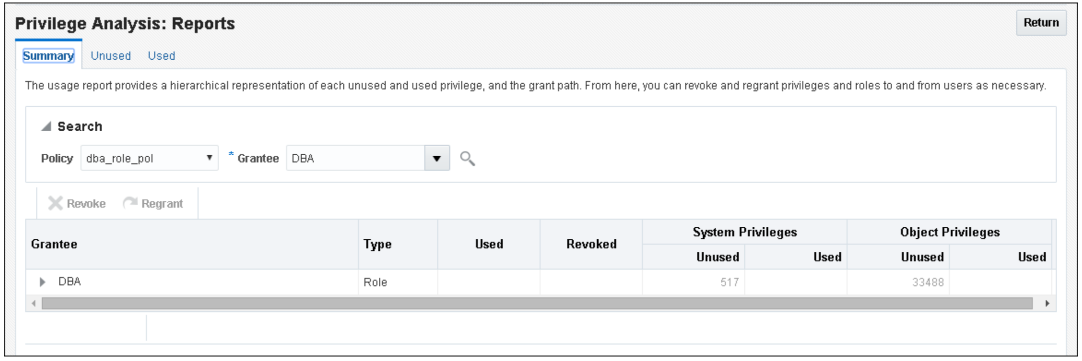
   In the Privilege Analysis page, a Confirmation message notifies you that a report has been submitted. You can refresh the page until the job is complete. To view the report, select the policy name and then click **View Reports**.

5.2.7.5 Accessing Privilege Analysis Reports Using Cloud Control

A privilege analysis report provides information about both used and unused privileges.

1. Generate the privilege analysis report.
2. In the Privilege Analysis page, select the policy on which you generated a report.
3. Select **View Reports**.

   The Privilege Analysis Reports page appears.



The usage report provides a hierarchical representation of each unused and used privilege, and the grant path. From here, you can revoke and regrant privileges and roles to and from users as necessary.

Policy: dba_role_pol
* Grantee: DBA

Grantee	Type	Used	Revoked	System Privileges		Object Privileges	
				Unused	Used	Unused	Used
DBA	Role			517		33488	

4. To view the report, do the following:
   - By default, the selected report will appear, but to search for a report for another policy, use the Search region to find a different report, or to select a different grantee for the currently selected policy.
   - To view unused privileges, select the **Unused** tab; to view the used privileges, select **Used**. To view a summary of both, select **Summary**.

   From here, you can select roles to revoke or regrant to users as necessary. To do so, under **Grantee**, select the role and then click **Revoke** or **Regrant**.

Related Topics

- Generating a Privilege Analysis Report Using Cloud Control
  You can generate a privilege analysis report using Cloud Control.

5.2.8 Dropping a Privilege Analysis Policy

Before you can drop a privilege analysis policy, you must first disable it.

Dropping a privilege analysis policy also drops all the used and unused privilege records associated with this privilege analysis. If you created capture runs for the policy, then they are dropped when you drop the policy.

1. Log in to the CDB or PDB as a user who has the `CAPTURE_ADMIN` role.

   To find the available PDBs in a CDB, log in to the CDB root container and then query the `PDB_NAME` column of the `DBA_PDBS` data dictionary view. To check the current container, run the `show con_name` command.
2. Query the `NAME` and `ENABLE` columns of the `DBA_PRIV_CAPTURES` data dictionary view to find the policy and to check if it is enabled or disabled.
3. If the policy is enabled, then disable it.

   For example:

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE ('logon_users_analysis_pol');
   ```
4. Run the `DBMS_PRIVILEGE_CAPTURE.DROP_CAPTURE` procedure to drop the policy.

   For example:

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DROP_CAPTURE ('logon_users_analysis_pol');
   ```

   If you had enabled the policy with a capture run, then the capture run is dropped as well. To individually drop a capture run, you can run the `DBMS_PRIVILEGE_CAPTURE.DELETE_RUN` procedure, but the policy must exist before you can run this statement.

Related Topics

- Disabling a Privilege Analysis Policy
  You must disable the privilege analysis policy before you can generate a privilege analysis report.

5.3 Creating Roles and Managing Privileges Using Cloud Control

You can create new roles using privileges found in a privilege analysis report and then grant this role to users.

- Creating a Role from a Privilege Analysis Report in Cloud Control
  You can use the report summary to find the least number of privileges an application needs, and encapsulate these privileges into a role.
- Revoking and Regranting Roles and Privileges Using Cloud Control
  You can use Enterprise Manager Cloud Control to revoke and regrant roles and privileges to users.
- Generating a Revoke or Regrant Script Using Cloud Control
  You can generate a script that revokes or regrants privileges from and to users, based on the results of privilege analysis reports.

5.3.1 Creating a Role from a Privilege Analysis Report in Cloud Control

You can use the report summary to find the least number of privileges an application needs, and encapsulate these privileges into a role.

1. Log in to Cloud Control as a user who has been granted the `CAPTURE_ADMIN` role and the `SELECT ANY DICTIONARY` privilege.

   Oracle Database 2 Day DBA explains how to log in.
2. On the Privilege Analysis page, select the policy name, and then from **Actions** menu, click **Create Role**.
3. On the Create Role page, provide the following details, and then click **OK**:
   - Select the policy from which you would like to create a new role.
   - Enter a unique name for the new role that you want to create.
   - Select the **Used** or **Unused** check box, depending on what your role must encapsulate. The role can have used or unused system and object privileges and roles.
   - Select the corresponding radio buttons for **Directly Granted System Privileges**, **Directly Granted Object Privileges**, and **Directly Granted Roles**.

     For example, if you select the **Used** check box, and select:
     - **All** system privileges, then all the used system privileges captured are included in the new role that you are creating.
     - **None** for role, then no role that is captured in the policy will be used in the new role.
     - **Customize** object privileges, then a list of available used objects privileges captured are displayed, you need to select the privileges from the list to assign to the role.

5.3.2 Revoking and Regranting Roles and Privileges Using Cloud Control

You can use Enterprise Manager Cloud Control to revoke and regrant roles and privileges to users.

1. If Oracle Database Vault is enabled, then ensure that you are authorized as an owner of the Oracle System Privilege and Role Management realm.

   In SQL*Plus, a user who has been granted the `DV_OWNER` role can check the authorization by querying the `DBA_DV_REALM_AUTH` data dictionary view. To grant the user authorization, use the `DBMS_MACADM.ADD_AUTH_TO_REALM` procedure.
2. Generate the privilege analysis report.
3. In the Privilege Analysis page, select the policy on which you generated a report.
4. Select **View Reports**.
5. In the Privilege Analysis: Reports page, select the **Summary** tab.
6. Under Search, ensure that the **Policy** and **Grantee** menu options are set.
7. Under the Grantee area, expand the grantee options.

   For example, for a role privilege analysis report for a role called `HR_ADMIN` role, you would expand the `HR_ADMIN` role to show the privileges that are associated with it.

8. Select each privilege to revoke and then click **Revoke**, or select **Regrant** to regrant the privilege to the role.

Related Topics

- Generating a Privilege Analysis Report Using Cloud Control
  You can generate a privilege analysis report using Cloud Control.

5.3.3 Generating a Revoke or Regrant Script Using Cloud Control

You can generate a script that revokes or regrants privileges from and to users, based on the results of privilege analysis reports.

- About Generating Revoke and Regrant Scripts
  You can perform a bulk revoke of unused system and object privileges and roles by using scripts that you can download after you have generated the privilege analysis.
- Generating a Revoke Script
  You can use Enterprise Manager Cloud Control to generate a script that revokes privileges from users.
- Generating a Regrant Script
  You can use Enterprise Manager Cloud Control to generate a script that regrants privileges that have been revoked from users.

5.3.3.1 About Generating Revoke and Regrant Scripts

You can perform a bulk revoke of unused system and object privileges and roles by using scripts that you can download after you have generated the privilege analysis.

Later on, if you want to regrant these privileges back to the user, you can generate a regrant script. In order to generate the regrant script, you must have a corresponding revoke script.

Run the revoke scripts in a development or test environment. Be aware that you cannot revoke privileges and roles from Oracle-supplied accounts and roles.

5.3.3.2 Generating a Revoke Script

You can use Enterprise Manager Cloud Control to generate a script that revokes privileges from users.

1. If Oracle Database Vault is enabled, then ensure that you are authorized as an owner of the Oracle System Privilege and Role Management realm.

   In SQL*Plus, a user who has been granted the `DV_OWNER` role can check the authorization by querying the `DBA_DV_REALM_AUTH` data dictionary view. To grant the user authorization, use the `DBMS_MACADM.ADD_AUTH_TO_REALM` procedure.
2. In Enterprise Manager, access the target Database home page as a user who has been granted the `CAPTURE_ADMIN` role and the `SELECT ANY DICTIONARY` privilege.
3. From the **Security** menu, select **Privilege Analysis**.
4. Ensure that the privilege analysis reports that you want have been generated.
5. In the Privilege Analysis page, from the **Actions** menu, select **Revoke Scripts**.
6. On the Revoke Scripts page, click **Generate**.

   The generate revoke script details wizard is displayed.

7. In the Script Details page, do the following: select a policy name from the **Policy Name** menu against which the revoke script needs to be prepared.
8. In the **Script Name** field, enter a unique name and for **Description**, a description for the script.

   For example, if you want to revoke all the unused privileges, select the **All** option for all the unused privileges and roles, and click **Next**.

   Based on your selection, and the available privileges, all the unused system privileges, object privileges, and roles that are going to be revoked are displayed on the respective pages.
9. For **Grantee (user/role)**, select **All** or **Customize**.
10. Select **All**, **None**, or **Customize** for the **Unused System Privileges**, **Unused Object Privileges**, and **Unused Roles** settings.
11. Click **Next**.

    The next pages that appear depend on your selections of **All**, **None**, or **Customize**. If you selected all, the page displays a listing of the privileges. If you selected **None**, the page is bypassed. If you selected **Customize**, then you can individually select the privileges to revoke. The last page that appears is the Review page.
12. Click **Save**.

    The Revoke Scripts page appears.
13. In the Revoke Scripts page, select the newly created SQL script, and then click **Download Revoke Script** to download this script, which contains `REVOKE` SQL statements for each privilege or role.

    To view the script, click the **View Revoke Script** button.
14. To return to the Privilege Analysis page, click **Return**.

Related Topics

- Generating a Privilege Analysis Report Using Cloud Control
  You can generate a privilege analysis report using Cloud Control.

5.3.3.3 Generating a Regrant Script

You can use Enterprise Manager Cloud Control to generate a script that regrants privileges that have been revoked from users.

1. If Oracle Database Vault is enabled, then ensure that you are authorized as an owner of the Oracle System Privilege and Role Management realm.

   In SQL*Plus, a user who has been granted the `DV_OWNER` role can check the authorization by querying the `DBA_DV_REALM_AUTH` data dictionary view. To grant the user authorization, use the `DBMS_MACADM.ADD_AUTH_TO_REALM` procedure.
2. In Enterprise Manager, access the target Database home page as a user who has been granted the `CAPTURE_ADMIN` role and the `SELECT ANY DICTIONARY` privilege.
3. From the **Security** menu, select **Privilege Analysis**.
4. Ensure that the privilege analysis reports you want have been generated.
5. In the Privilege Analysis page, select the policy on which the revoke script was based.
6. From the **Actions** menu, select **Revoke Scripts**.

7. In the Revoke Scripts page, select the policy name that you had created earlier, and then click **Download Regrant Script** to download this script.

   You can view the scripts that are associated with the policy by selecting the **View Revoke Script** and **View Regrant Script** buttons.

Related Topics

- Generating a Privilege Analysis Report Using Cloud Control
  You can generate a privilege analysis report using Cloud Control.

5.4 Tutorial: Using Capture Runs to Analyze ANY Privilege Use

This tutorial demonstrates how to create capture runs to analyze the use of the `READ ANY TABLE` system privilege.

- Step 1: Create User Accounts
  You must create two users, one user to create the policy and a second user whose privilege use will be analyzed.
- Step 2: Create and Enable a Privilege Analysis Policy
  The user `pa_admin` must create and enable the privilege analysis policy.
- Step 3: Use the READ ANY TABLE System Privilege
  User `app_user` uses the `READ ANY TABLE` system privilege.
- Step 4: Disable the Privilege Analysis Policy
  You must disable the policy before you can generate a report that captures the actions of user `app_user`.
- Step 5: Generate and View a Privilege Analysis Report
  With the privilege analysis policy disabled, user `pa_admin` then can generate and view a privilege analysis report.
- Step 6: Create a Second Capture Run
  Next, you are ready to create a second capture run for the `ANY_priv_analysis_pol` privilege analysis policy.
- Step 7: Remove the Components for This Tutorial
  You can remove the components that you created for this tutorial if you no longer need them.

5.4.1 Step 1: Create User Accounts

You must create two users, one user to create the policy and a second user whose privilege use will be analyzed.

1. Log into a PDB as a user who has the `CREATE USER` system privilege.

   For example:

   ```
   sqlplus sec_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.

2. Create the following users:

   ```
   CREATE USER pa_admin IDENTIFIED BY password;
   CREATE USER app_user IDENTIFIED BY password;
   ```

Replace *password* with a password that is secure.

3. Connect as a user who has the privileges to grant roles and system privileges to other users, and who has been granted the owner authorization for the Oracle System Privilege and Role Management realm. (User `SYS` has these privileges by default.)

   For example:

   ```
   CONNECT dba_psmith@pdb_name
   Enter password: password
   ```

   In SQL*Plus, a user who has been granted the `DV_OWNER` role can check the authorization by querying the `DBA_DV_REALM_AUTH` data dictionary view. To grant the user authorization, use the `DBMS_MACADM.ADD_AUTH_TO_REALM` procedure.

4. Grant the following role and privilege to the users.

   ```
   GRANT CREATE SESSION, CAPTURE_ADMIN TO pa_admin;
   GRANT CREATE SESSION, READ ANY TABLE TO app_user;
   ```

   User `pa_admin` will create the privilege analysis policy that will analyze the `READ ANY TABLE` query that user `app_user` will perform.

Related Topics

- Guidelines for Securing Passwords
  Oracle provides guidelines for securing passwords in a variety of situations.

5.4.2 Step 2: Create and Enable a Privilege Analysis Policy

The user `pa_admin` must create and enable the privilege analysis policy.

1. Connect to the PDB as user `pa_admin`.

   ```
   CONNECT pa_admin@pdb_name
   Enter password: password
   ```

2. Create the following privilege analysis policy:

   ```
   BEGIN
    DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
     name           => 'ANY_priv_analysis_pol',
     description    => 'Analyzes system privilege use',
     type           => DBMS_PRIVILEGE_CAPTURE.G_CONTEXT,
     condition      => 'SYS_CONTEXT(''USERENV'', ''SESSION_USER'')=''APP_USER''');
   END;
   /
   ```

   In this example:

   - `type` specifies the type of capture condition that is defined by the `condition` parameter, described next. In this policy, the type is a context-based condition.
   - `condition` specifies condition using a Boolean expression that must evaluate to `TRUE` for the policy to take effect. In this case, the condition checks if the session user is `app_user`.

3. Enable the policy and create a capture run for it.

   ```
   BEGIN
     DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE (
      name       => 'ANY_priv_analysis_pol',
      run_name   => 'ANY_priv_pol_run_1');
   ```

```
END;
/
```

At this point, the policy is ready to start recording the actions of user `app_user`.

5.4.3 Step 3: Use the READ ANY TABLE System Privilege

User `app_user` uses the `READ ANY TABLE` system privilege.

1. Connect as user `app_user`.

   ```
   CONNECT app_user@pdb_name
   Enter password: password
   ```

2. Query the `HR.EMPLOYEES` table.

   ```
   SELECT FIRST_NAME, LAST_NAME, SALARY FROM HR.EMPLOYEES WHERE SALARY > 12000 ORDER BY
   SALARY DESC;

   FIRST_NAME           LAST_NAME                     SALARY
   -------------------- ------------------------- ----------
   Steven               King                           24000
   Neena                Kochhar                        17000
   Lex                  De Haan                        17000
   John                 Russell                        14000
   Karen                Partners                       13500
   Michael              Hartstein                      13000
   Shelley              Higgins                        12008
   Nancy                Greenberg                      12008
   ```

5.4.4 Step 4: Disable the Privilege Analysis Policy

You must disable the policy before you can generate a report that captures the actions of user `app_user`.

1. Connect as user `pa_admin`.

   ```
   CONNECT pa_admin@pdb_name
   Enter password: password
   ```

2. Disable the `ANY_priv_analysis_pol` privilege policy.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE ('ANY_priv_analysis_pol');
   ```

5.4.5 Step 5: Generate and View a Privilege Analysis Report

With the privilege analysis policy disabled, user `pa_admin` then can generate and view a privilege analysis report.

1. As user `pa_admin`, generate the privilege analysis results.

   ```
   BEGIN
     DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT (
       name      => 'ANY_priv_analysis_pol',
       run_name  => 'ANY_priv_pol_run_1');
   END;
   /
   ```

   The generated results are stored in the privilege analysis data dictionary views.

2. Enter the following commands to format the data dictionary view output:

```
col username format a10
col sys_priv format a16
col object_owner format a13
col object_name format a23
col run_name format a27
```

3. Find the system privileges that `app_user` used and the objects on which `app_user` used them during the privilege analysis period.

   ```
   SELECT SYS_PRIV, OBJECT_OWNER, OBJECT_NAME, RUN_NAME FROM DBA_USED_PRIVS WHERE
   USERNAME = 'APP_USER';
   ```

   Output similar to the following appears. The first row shows that `app_user` used the `READ ANY TABLE` privilege on the `HR.EMPLOYEES` table.

   ```
   SYS_PRIV         OBJECT_OWNER  OBJECT_NAME             RUN_NAME
   ---------------- ------------- ----------------------- ------------------
                    SYSTEM        PRODUCT_PRIVS           ANY_PRIV_POL_RUN_1
                    SYS           DUAL                    ANY_PRIV_POL_RUN_1
                    SYS           DUAL                    ANY_PRIV_POL_RUN_1
   CREATE SESSION                                         ANY_PRIV_POL_RUN_1
                    SYS           DBMS_APPLICATION_INFO   ANY_PRIV_POL_RUN_1
   READ ANY TABLE   HR            EMPLOYEES               ANY_PRIV_POL_RUN_1
   ```

At this stage, the privilege analysis results remain available in the privilege analysis data dictionary views, even if you create additional capture runs in the future.

5.4.6 Step 6: Create a Second Capture Run

Next, you are ready to create a second capture run for the `ANY_priv_analysis_pol` privilege analysis policy.

1. As user `pa_admin`, enable the `ANY_priv_analysis_pol` privilege analysis policy to use capture run `ANY_priv_pol_run_1`.

   ```
   BEGIN
     DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE (
      name        => 'ANY_priv_analysis_pol',
      run_name    => 'ANY_priv_pol_run_2');
   END;
   /
   ```

2. Connect as user `app_user`.

   ```
   CONNECT app_user@pdb_name
   Enter password: password
   ```

3. Query the `HR.JOBS` table.

   ```
   SELECT MAX_SALARY FROM HR.JOBS WHERE MAX_SALARY > 20000;
   ```

4. Connect as user `pa_admin`.

   ```
   CONNECT pa_admin@pdb_name
   Enter password: password
   ```

5. Disable the `ANY_priv_analysis_pol` privilege policy.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE ('ANY_priv_analysis_pol');
   ```

6. Generate a second privilege analysis report.

   ```
   BEGIN
     DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT (
       name       => 'ANY_priv_analysis_pol',
   ```

```
    run_name  => 'ANY_priv_pol_run_2');
END;
/
```

7. Find the system privileges that `app_user` used and the objects on which this user used them during the privilege analysis period.

   ```
   SELECT SYS_PRIV, OBJECT_OWNER, OBJECT_NAME, RUN_NAME FROM DBA_USED_PRIVS WHERE
   USERNAME = 'APP_USER' ORDER BY RUN_NAME;
   ```

   Output similar to the following appears, which now shows the results of both of the capture runs that user `pa_admin` created.

   ```
   SYS_PRIV         OBJECT_OWNER  OBJECT_NAME             RUN_NAME
   ---------------- ------------- ----------------------- ----------------------
   READ ANY TABLE   HR            EMPLOYEES               ANY_PRIV_POL_RUN_1
                    SYS           DUAL                    ANY_PRIV_POL_RUN_1
   CREATE SESSION                                         ANY_PRIV_POL_RUN_1
                    SYS           DUAL                    ANY_PRIV_POL_RUN_1
                    SYSTEM        PRODUCT_PRIVS           ANY_PRIV_POL_RUN_1
                    SYS           DBMS_APPLICATION_INFO   ANY_PRIV_POL_RUN_1
                    SYS           DUAL                    ANY_PRIV_POL_RUN_2
                    SYS           DBMS_APPLICATION_INFO   ANY_PRIV_POL_RUN_2
                    SYSTEM        PRODUCT_PRIVS           ANY_PRIV_POL_RUN_2
                    SYS           DUAL                    ANY_PRIV_POL_RUN_2
   READ ANY TABLE   HR            JOBS                    ANY_PRIV_POL_RUN_2
   ```

5.4.7 Step 7: Remove the Components for This Tutorial

You can remove the components that you created for this tutorial if you no longer need them.

1. As user `pa_admin`, drop the `ANY_priv_analysis_pol` privilege analysis policy and its associated capture runs.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DROP_CAPTURE ('ANY_priv_analysis_pol');
   ```

   Any capture runs that are associated with this policy are dropped automatically when you run the `DBMS_PRIVILEGE_CAPTURE.DROP_CAPTURE` procedure.

   Even though in the next steps you will drop the `pa_admin` user, including any objects created in this user's schema, you must manually drop the `ANY_priv_analysis_pol` privilege analysis policy because this object resides in the `SYS` schema.

2. Connect as the user who created the user accounts.

   For example:

   ```
   CONNECT sec_admin@pdb_name
   Enter password: password
   ```

3. Drop the users `pa_admin` and `app_user`.

   ```
   DROP USER pa_admin CASCADE;
   DROP USER app_user;
   ```

5.5 Tutorial: Analyzing Privilege Use by a User Who Has the DBA Role

This tutorial demonstrates how to analyze the privilege use of a user who has the `DBA` role and performs database tuning operations.

- Step 1: Create User Accounts
  You must create two users, one to create the privilege analysis policy and a second user whose privilege use will be analyzed.
- Step 2: Create and Enable a Privilege Analysis Policy
  User `pa_admin` must create the and enable the privilege analysis policy.
- Step 3: Perform the Database Tuning Operations
  User `tjones` uses the `DBA` role to perform database tuning operations.
- Step 4: Disable the Privilege Analysis Policy
  You must disable the policy before you can generate a report that captures the actions of user `tjones`.
- Step 5: Generate and View Privilege Analysis Reports
  With the privilege analysis policy disabled, user `pa_admin` can generate and view privilege analysis reports.
- Step 6: Remove the Components for This Tutorial
  You can remove the components that you created for this tutorial if you no longer need them.

5.5.1 Step 1: Create User Accounts

You must create two users, one to create the privilege analysis policy and a second user whose privilege use will be analyzed.

1. Log into a PDB as a user who has the `CREATE USER` system privilege.

   For example:

   ```
   sqlplus sec_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.

2. Create the following users:

   ```
   CREATE USER pa_admin IDENTIFIED BY password;
   CREATE USER tjones IDENTIFIED BY password;
   ```

   Replace *`password`* with a password that is secure.

3. Connect as a user who has the privileges to grant roles and system privileges to other users, and who has been granted the owner authorization for the Oracle System Privilege and Role Management realm. (User `SYS` has these privileges by default.)

   For example:

   ```
   CONNECT dba_psmith@pdb_name
   Enter password: password
   ```

   In SQL*Plus, a user who has been granted the `DV_OWNER` role can check the authorization by querying the `DBA_DV_REALM_AUTH` data dictionary view. To grant the user authorization, use the `DBMS_MACADM.ADD_AUTH_TO_REALM` procedure.

4. Grant the following roles and privileges to the users.

   ```
   GRANT CREATE SESSION, CAPTURE_ADMIN TO pa_admin;
   GRANT CREATE SESSION, DBA TO tjones;
   ```

User `pa_admin` will create the privilege analysis policy that will analyze the database tuning operations that user `tjones` will perform.

Related Topics

- Guidelines for Securing Passwords
  Oracle provides guidelines for securing passwords in a variety of situations.

5.5.2 Step 2: Create and Enable a Privilege Analysis Policy

User `pa_admin` must create the and enable the privilege analysis policy.

1. Connect to the PDB as user `pa_admin`.

```
CONNECT pa_admin@pdb_name
Enter password: password
```

2. Create the following privilege analysis policy:

```
BEGIN
 DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
  name              => 'dba_tuning_priv_analysis_pol',
  description       => 'Analyzes DBA tuning privilege use',
  type              => DBMS_PRIVILEGE_CAPTURE.G_CONTEXT,
  condition         => 'SYS_CONTEXT(''USERENV'', ''SESSION_USER'')=''TJONES''');
END;
/
```

In this example:

- `type` specifies the type of capture condition that is defined by the `condition` parameter, described next. In this policy, the type is a context-based condition.
- `condition` specifies condition using a Boolean expression that must evaluate to `TRUE` for the policy to take effect. In this case, the condition checks if the session user is `tjones`.

3. Enable the policy.

```
EXEC DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE ('dba_tuning_priv_analysis_pol');
```

At this point, the policy is ready to start recording the actions of user `tjones`.

5.5.3 Step 3: Perform the Database Tuning Operations

User `tjones` uses the `DBA` role to perform database tuning operations.

1. Connect to the PDB as user `tjones`.

```
CONNECT tjones@pdb_name
Enter password: password
```

2. Run the following script to create the `PLAN_TABLE` table.

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

The location of this script may vary depending on your operating system. This script creates the `PLAN_TABLE` table in the `tjones` schema.

3. Run the following `EXPLAIN PLAN` SQL statement on the `HR.EMPLOYEES` table:

```
EXPLAIN PLAN
 SET STATEMENT_ID = 'Raise in Tokyo'
 INTO PLAN_TABLE
 FOR UPDATE HR.EMPLOYEES
 SET SALARY = SALARY * 1.10
 WHERE DEPARTMENT_ID =
  (SELECT DEPARTMENT_ID FROM HR.DEPARTMENTS WHERE LOCATION_ID = 110);
```

Next, user `tjones` will analyze the `HR.EMPLOYEES` table.

4. Run either of the following scripts to create the `CHAINED_ROWS` table

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

   Or

   ```
   @$ORACLE_HOME/rdbms/admin/utlchn1.sql
   ```

5. Run the `ANALYZE TABLE` statement on the `HR.EMPLOYEES` table.

   ```
   ANALYZE TABLE HR.EMPLOYEES LIST CHAINED ROWS INTO CHAINED_ROWS;
   ```

5.5.4 Step 4: Disable the Privilege Analysis Policy

You must disable the policy before you can generate a report that captures the actions of user `tjones`.

1. Connect as user `pa_admin`.

   ```
   CONNECT pa_admin@pdb_name
   Enter password: password
   ```

2. Disable the `dba_tuning_priv_analysis_pol` privilege policy.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE ('dba_tuning_priv_analysis_pol');
   ```

5.5.5 Step 5: Generate and View Privilege Analysis Reports

With the privilege analysis policy disabled, user `pa_admin` can generate and view privilege analysis reports.

1. As user `pa_admin`, generate the privilege analysis results.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT ('dba_tuning_priv_analysis_pol');
   ```

   The generated results are stored in the privilege analysis data dictionary views.

2. Enter the following commands to format the data dictionary view output:

   ```
   col username format a8
   col sys_priv format a18
   col used_role format a20
   col path format a150
   col obj_priv format a10
   col object_owner format a10
   col object_name format a10
   col object_type format a10
   ```

3. Find the system privileges and roles that user `tjones` used during the privilege analysis period.

   ```
   SELECT USERNAME, SYS_PRIV, USED_ROLE, PATH
    FROM DBA_USED_SYSPRIVS_PATH
    WHERE USERNAME = 'TJONES'
    ORDER BY 1, 2, 3;
   ```

Output similar to the following appears:

```
USERNAME SYS_PRIV           USED_ROLE
-------- ------------------ --------------------
PATH
--------------------------------------------------------------------------------
TJONES   ANALYZE ANY        IMP_FULL_DATABASE
GRANT_PATH('TJONES', 'DBA')

TJONES   ANALYZE ANY        IMP_FULL_DATABASE
GRANT_PATH('TJONES', 'DBA', 'IMP_FULL_DATABASE')

TJONES   ANALYZE ANY        IMP_FULL_DATABASE
GRANT_PATH('TJONES', 'DBA', 'DATAPUMP_IMP_FULL_DATABASE', 'IMP_FULL_DATABASE')
...
```

4. Find the object privileges and roles that user `tjones` used during the privilege analysis period.

```
col username format a9
col used_role format a10
col object_name format a22
col object_type format a12

SELECT USERNAME, OBJ_PRIV, USED_ROLE,
 OBJECT_OWNER, OBJECT_NAME, OBJECT_TYPE
 FROM DBA_USED_OBJPRIVS
 WHERE USERNAME = 'TJONES'
 ORDER BY 1, 2, 3, 4, 5, 6;
```

Output similar to the following appears:

```
USERNAME  OBJ_PRIV   USED_ROLE  OBJECT_OWN OBJECT_NAME            OBJECT_TYPE
--------- ---------- ---------- ---------- ---------------------- ------------
TJONES    EXECUTE    PUBLIC     SYS        DBMS_APPLICATION_INFO  PACKAGE
TJONES    SELECT     PUBLIC     SYS        DUAL                   TABLE
TJONES    SELECT     PUBLIC     SYS        DUAL                   TABLE
TJONES    SELECT     PUBLIC     SYSTEM     PRODUCT_PRIVS          VIEW
...
```

5. Find the unused system privileges for user `tjones`.

```
col username format a9
col sys_priv format a35

SELECT USERNAME, SYS_PRIV
 FROM DBA_UNUSED_SYSPRIVS
 WHERE USERNAME = 'TJONES'
 ORDER BY 1, 2;

USERNAME SYS_PRIV
-------- ------------------------------
TJONES   ADMINISTER ANY SQL TUNING SET
TJONES   ADMINISTER DATABASE TRIGGER
TJONES   ADMINISTER RESOURCE MANAGER
TJONES   ADMINISTER SQL TUNING SET
TJONES   ALTER ANY ASSEMBLY
TJONES   ON COMMIT REFRESH
...
```

5.5.6 Step 6: Remove the Components for This Tutorial

You can remove the components that you created for this tutorial if you no longer need them.

1. As user `pa_admin`, drop the `dba_tuning_priv_analysis_pol` privilege analysis policy.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DROP_CAPTURE ('dba_tuning_priv_analysis_pol');
   ```

   Even though in the next steps you will drop the `pa_admin` user, including any objects created in this user's schema, you must manually drop the `dba_tuning_priv_analysis_pol` privilege analysis policy because this object resides in the `SYS` schema.

2. Connect as the user who created the user accounts.

   For example:

   ```
   CONNECT sec_admin@pdb_name
   Enter password: password
   ```

3. Drop the users `pa_admin` and `tjones`.

   ```
   DROP USER pa_admin CASCADE;
   DROP USER tjones;
   ```

5.6 Tutorial: Capturing Schema Privilege Use

This tutorial shows how to capture a user's schema privilege use for the `SELECT ANY TABLE` and `DELETE ANY TABLE` system privileges on the `HR` schema.

- Step 1: Create User Accounts
  You must create two users, one to create the privilege analysis policy and a second user whose schema privilege use will be analyzed.
- Step 2: Create and Enable a Privilege Analysis Policy
  User `pa_admin` must create the and enable the privilege analysis policy.
- Step 3: Use the READ ANY TABLE System Privilege
  User `sec_user` uses the `SELECT ANY TABLE` system privilege on the `HR` schema.
- Step 4: Disable the Privilege Analysis Policy
  You must disable the policy before you can generate a report that captures the actions of user `sec_user`.
- Step 5: Generate and View Privilege Analysis Reports
  With the privilege analysis policy disabled, user `pa_admin` can generate and view privilege analysis reports.
- Step 6: Remove the Components for This Tutorial
  You can remove the components that you created for this tutorial if you no longer need them.

5.6.1 Step 1: Create User Accounts

You must create two users, one to create the privilege analysis policy and a second user whose schema privilege use will be analyzed.

1. Log into a PDB as a user who has the `CREATE USER` system privilege.

   For example:

```
sqlplus sec_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.

2. Create the following users:

   ```
   CREATE USER pa_admin IDENTIFIED BY password;
   CREATE USER sec_user IDENTIFIED BY password;
   ```

   Replace *`password`* with a password that is secure.

3. Connect as a user who has the privileges to grant roles and system privileges to other users, and who has been granted the owner authorization for the Oracle System Privilege and Role Management realm. (User `SYS` has these privileges by default.)

   For example:

   ```
   CONNECT dba_psmith@pdb_name
   Enter password: password
   ```

   In SQL*Plus, a user who has been granted the `DV_OWNER` role can check the authorization by querying the `DBA_DV_REALM_AUTH` data dictionary view. To grant the user authorization, use the `DBMS_MACADM.ADD_AUTH_TO_REALM` procedure.

4. Grant the following roles and privileges to the users.

   ```
   GRANT CREATE SESSION, CAPTURE_ADMIN TO pa_admin;
   GRANT CREATE SESSION TO sec_user;
   ```

   User `pa_admin` will create the privilege analysis policy that will analyze the database tuning operations that user `sec_user` will perform.

5. For user `sec_user`, grant the `SELECT ANY TABLE` and `DELETE ANY TABLE` system privileges as schema privileges for the `HR` schema.

   ```
   GRANT SELECT ANY TABLE, DELETE ANY TABLE ON SCHEMA HR TO sec_user;
   ```

Related Topics

- Guidelines for Securing Passwords
  Oracle provides guidelines for securing passwords in a variety of situations.

5.6.2 Step 2: Create and Enable a Privilege Analysis Policy

User `pa_admin` must create the and enable the privilege analysis policy.

1. Connect to the PDB as user `pa_admin`.

   ```
   CONNECT pa_admin@pdb_name
   Enter password: password
   ```

2. Create the following privilege analysis policy:

   ```
   BEGIN
    DBMS_PRIVILEGE_CAPTURE.CREATE_CAPTURE(
     name          => 'sec_user_capture_pol',
     description   => 'Captures sec_user used and not used privileges',
     type          => DBMS_PRIVILEGE_CAPTURE.G_DATABASE);
   END;
   /
   ```

In this example, `type` specifies that the type is a database wide condition.

3. Enable the policy.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.ENABLE_CAPTURE ('sec_user_capture_pol');
   ```

   At this point, the policy is ready to start recording the actions of user `sec_user`.

5.6.3 Step 3: Use the READ ANY TABLE System Privilege

User `sec_user` uses the `SELECT ANY TABLE` system privilege on the `HR` schema.

1. Connect as user `sec_user`.

   ```
   CONNECT sec_user@pdb_name
   Enter password: password
   ```

2. Query the `HR.EMPLOYEES` table.

   ```
   SELECT FIRST_NAME, LAST_NAME FROM HR.EMPLOYEES WHERE SALARY > 8000;

   FIRST_NAME           LAST_NAME
   -------------------- -------------------------
   Steven               King
   Neena                Kochhar
   Lex                  De Haan
   Alexander            Hunold
   Nancy                Greenberg
   Daniel               Faviet
   ...
   ```

5.6.4 Step 4: Disable the Privilege Analysis Policy

You must disable the policy before you can generate a report that captures the actions of user `sec_user`.

1. Connect as user `pa_admin`.

   ```
   CONNECT pa_admin@pdb_name
   Enter password: password
   ```

2. Disable the `sec_user_capture_pol` privilege policy.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.DISABLE_CAPTURE ('sec_user_capture_pol');
   ```

5.6.5 Step 5: Generate and View Privilege Analysis Reports

With the privilege analysis policy disabled, user `pa_admin` can generate and view privilege analysis reports.

1. As user `pa_admin`, generate the privilege analysis results.

   ```
   EXEC DBMS_PRIVILEGE_CAPTURE.GENERATE_RESULT ('sec_user_capture_pol');
   ```

   The generated results are stored in the privilege analysis data dictionary views.

2. Enter the following commands to format the data dictionary view output:

   ```
   col sch_priv format a20
   col schema format a20
   ```

3. Find the schema privileges that user `sec_user` used during the privilege analysis period.

```
SELECT SCH_PRIV, SCHEMA FROM DBA_USED_SCHEMA_PRIVS WHERE USERNAME = 'SEC_USER';
```

Output similar to the following appears:

```
SCH_PRIV         SCHEMA
-------------------- --------------------
SELECT ANY TABLE     HR
```

4. Find the unused schema privileges for user `sec_user`.

```
SELECT SCH_PRIV, SCHEMA FROM DBA_UNUSED_SCHEMA_PRIVS WHERE USERNAME = 'SEC_USER';
```

Output similar to the following appears:

```
SCH_PRIV         SCHEMA
-------------------- --------------------
DELETE ANY TABLE     HR
```

5.6.6 Step 6: Remove the Components for This Tutorial

You can remove the components that you created for this tutorial if you no longer need them.

1. As user `pa_admin`, drop the `sec_user_capture_pol` privilege analysis policy.

```
EXEC DBMS_PRIVILEGE_CAPTURE.DROP_CAPTURE ('sec_user_capture_pol');
```

Even though in the next steps you will drop the `pa_admin` user, including any objects created in this user's schema, you must manually drop the `sec_user_capture_pol` privilege analysis policy because this object resides in the `SYS` schema.

2. Connect as the user who created the user accounts.

For example:

```
CONNECT sec_admin@pdb_name
Enter password: password
```

3. Drop the users `pa_admin` and `sec_user`.

```
DROP USER pa_admin CASCADE;
DROP USER sec_user;
```

5.7 Privilege Analysis Policy and Report Data Dictionary Views

Oracle Database provides a set of data dictionary views that provide information about analyzed privileges.

Table 5-1 lists these data dictionary views.

Table 5-1 Data Dictionary Views That Display Privilege Analysis Information

View	Description
`DBA_PRIV_CAPTURES`	Lists information about existing privilege analysis policies
`DBA_USED_SCHEMA_PRIVS`	Lists the schema privileges that are used for the privilege analysis policies
`DBA_USED_SCHEMA_PRIVS_PATH`	Lists the schema privileges that are used for the privilege analysis policies. It includes the schema privilege grant paths.

Table 5-1 (Cont.) Data Dictionary Views That Display Privilege Analysis Information

View	Description
DBA_USED_PRIVS	Lists the privileges and capture runs that have been used for reported privilege analysis policies
DBA_UNUSED_GRANTS	Lists the privilege grants that have not been used
DBA_UNUSED_PRIVS	Lists the privileges and capture runs that have not been used for reported privilege analysis policies
DBA_UNUSED_SCHEMA_PRIVS	Lists the system privileges that are not used for the privilege analysis policies
DBA_UNUSED_SCHEMA_PRIVS_PATH	Lists the system privileges that are not used for the privilege analysis policies. It includes the schema privilege grant paths.
DBA_USED_OBJPRIVS	Lists the object privileges and capture runs that have been used for reported privilege analysis policies. It does not include the object grant paths.
DBA_UNUSED_OBJPRIVS	Lists the object privileges and capture runs that have not been used for reported privilege analysis policies. It does not include the object privilege grant paths.
DBA_USED_OBJPRIVS_PATH	Lists the object privileges and capture runs that have been used for reported privilege analysis policies. It includes the object privilege grant paths.
DBA_UNUSED_OBJPRIVS_PATH	Lists the object privileges and capture runs that have not been used for reported privilege analysis policies. It includes the object privilege grant paths.
DBA_USED_SYSPRIVS	Lists the system privileges and capture runs that have been used for reported privilege analysis policies. It does not include the system privilege grant paths.
DBA_UNUSED_SYSPRIVS	Lists the system privileges and capture runs that have not been used for reported privilege analysis policies. It does not include the system privilege grant paths.
DBA_USED_SYSPRIVS_PATH	Lists the system privileges and capture runs that have been used for reported privilege analysis policies. It includes the system privilege grant paths.
DBA_UNUSED_SYSPRIVS_PATH	Lists the system privileges and capture runs that have not been used for reported privilege analysis policies. It includes system privilege grant paths
DBA_USED_PUBPRIVS	Lists all the privileges and capture runs for the PUBLIC role that have been used for reported privilege analysis policies
DBA_USED_USERPRIVS	Lists the user privileges and capture runs that have been used for reported privilege analysis policies. It does not include the user privilege grant paths.
DBA_UNUSED_USERPRIVS	Lists the user privileges and capture runs that have not been used for reported privilege analysis policies. It does not include the user privilege grant paths.
DBA_USED_USERPRIVS_PATH	Lists the user privileges and capture runs that have been used for reported privilege analysis policies. It includes the user privilege grant paths.

Table 5-1 (Cont.) Data Dictionary Views That Display Privilege Analysis Information

View	Description
`DBA_UNUSED_USERPRIVS_PATH`	Lists the privileges and capture runs that have not been used for reported privilege analysis policies. It includes the user privilege grant paths.

Related Topics

- *Oracle Database Reference*