#### **Oracle® Database**

**Database Security Assessment Tool User Guide** 

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# About the Oracle Database Security Assessment Tool

The Oracle Database Security Assessment Tool (Oracle DBSAT) analyzes database configurations, users, their entitlements, security policies and identifies where sensitive data resides to uncover security risks and improve the security posture of Oracle Databases within your organization.

# Benefits of Using Oracle Database Security Assessment Tool

Using Oracle DBSAT, you can:

- Quickly and easily assess the current security status and identify sensitive data within the Oracle Database.
- Reduce risk exposure using proven Oracle Database Security best practices, CIS benchmark recommendations and STIG rules.
- Leverage security findings to accelerate compliance with EU GDPR and other regulations.
- Improve the security posture of your Oracle Databases and promote security best practices.



DBSAT is a lightweight utility that will not impair system performance in a measurable way.

You can use Oracle DBSAT report findings to:

- Fix immediate short-term risks
- Implement a comprehensive security strategy



- Support your regulatory compliance program
- Promote security best practices

## Oracle Database Security Assessment Tool Components

The Oracle DBSAT consists of the following components:

#### Collector:

The **Collector** executes SQL queries and runs operating system commands to collect data from the system to be assessed. It does this primarily by querying database dictionary views. The collected data is written to a JSON file that is used by the DBSAT Reporter in the analysis phase. Note that if the collector is executed remotely it will not collect operating system data. It is recommended to run it in the database server to collect all relevant data.

#### Reporter:

The **Reporter** analyzes the collected data and generates the Oracle Database Security Assessment Report in HTML, Excel, JSON, and Text formats. The Reporter can run on any machine: PC, laptop, or server. You are not limited to running the Reporter on the database server or the same machine as the Collector.

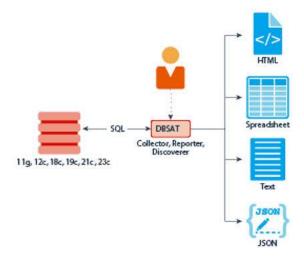
#### Discoverer:

The **Discoverer** executes SQL queries and collects metadata from the database to be assessed, based on the settings specified in the configuration files. It does this primarily by querying database dictionary views. The collected data is then used to generate the Oracle Database Sensitive Data Assessment Report in HTML and CSV formats. The Discoverer can run on any machine: PC, laptop, or server. You are not limited to running the Discoverer on the database server or the same machine as the Collector or Reporter.

The following figure shows the components, sources, and reports of the Oracle Database Security Assessment Tool.



Figure Oracle DBSAT Components, Sources, and Reports



For more information about the Collector, Reporter, and Discoverer, see Using the Collector and Reporter.

## **Prerequisites**

The following sections outline the prerequisites for the Oracle Database Security Assessment Tool:

## **Supported Operating Systems**

The database configuration collection queries run on most supported Oracle Database platforms. However, currently, DBSAT will skip OS data for databases running on Windows platforms.

#### Oracle DBSAT runs on:

- Solaris x64 and Solaris SPARC64
- Linux x86-64 and Linux 64-bit Arm
- Windows x64
- HP-UX IA (64-bit)
- IBM AIX (64-bit) and Linux on zSeries (64-bit)

## Supported Database Versions

You can run the Oracle DBSAT on Oracle Database 11.2.0.4 and later releases onpremises or in the Cloud, on Oracle Database Standard Edition 2 and Oracle Database Enterprise Edition. You can also run Oracle DBSAT against Autonomous



Databases (Serverless, Dedicated, and Cloud@Customer), Autonomous JSON Database, Oracle Exadata Database Service (Dedicated and Cloud@Customer), and Oracle Base Database Service (BaseDB Enterprise Edition and Standard Edition). Some findings will do different checks and provide targeted remarks for these databases. For more information about the target-specific checks and recommendations, see Appendix A.

## **Security Requirements**

Oracle DBSAT output files are sensitive because they may reveal weaknesses in the security posture of your database. To prevent unauthorized access to these files, you must implement the following security guidelines:

- Ensure that the directories holding these files are secured with the appropriate permissions.
- Delete the files securely after you implement the recommendations they contain.
- Share them with others in their (by default) encrypted form.
- Grant user permissions to the Oracle DBSAT user on a short-term basis and revoke these when no longer necessary.

For more information about Oracle DBSAT user privileges, see Collector Prerequisites. For more information about Oracle DBSAT best practices, see: Best Practices



#### Caution:

This tool is intended to assist you in identifying potential sensitive data and vulnerabilities in your system. Further, the output generated by this tool may include potentially sensitive system configuration data and information that could be used by a skilled attacker to penetrate your system. You are solely responsible for ensuring that the output of this tool, including any generated reports, is handled in accordance with your company's policies.

## Oracle Database Security Assessment Tool Prerequisites

DBSAT on Unix/Linux systems must execute under the BASH shell. If the server does not have this shell, you can install it or run DBSAT remotely from a different server that has it (or from a laptop running Windows, from where you can connect to the database).

### Zip and UnZip

Oracle DBSAT uses Zip and Unzip to compress or decompress the generated files. Oracle DBSAT searches for Zip and Unzip utilities in the default locations shown below. In order to use other Zip and Unzip utilities, update the following lines in the relevant script.



#### Windows (dbsat.bat script):

```
SET ZIP_CMD=%ORACLE_HOME%\bin\zip.exe
SET UNZIP CMD=%ORACLE HOME%\bin\unzip.exe
```



The Unzip utility is not included in Oracle Database 12.2 and higher. Ensure that you have installed a utility such as WinZip or WinRar, and add the path to the utility in the SET UNZIP CMD parameter.

#### All other platforms (dbsat script):

```
ZIP=/usr/bin/zip
UNZIP=/usr/bin/unzip
DBZIP=${ORACLE HOME}/bin/zip
```

The following are the prerequisites for the components of the Oracle Database Security Assessment Tool:

### Collector Prerequisites

To gather all necessary data, run the Oracle DBSAT Collector on the server that hosts the database. The collector uses operating system commands to gather process and file system information that the database alone cannot provide. Besides, the Oracle DBSAT Collector must be run as an OS user with read permissions on files and directories under <code>ORACLE\_HOME</code> using SQL\*Plus (through Oracle Database or Instant Client) to collect and process file system data using OS commands.

The Oracle DBSAT Collector collects most of its data by querying database views. It must connect to the database as a user with sufficient privileges to select from these views. Grant the DBSAT user the following privileges:

- CREATE SESSION
- READ or SELECT on SYS.REGISTRY\$HISTORY
- Role SELECT CATALOG ROLE
- Role DV\_SECANALYST (if Database Vault is enabled or if Database Vault Operations Control is enabled)
- Role AUDIT VIEWER (12c and later)
- Role CAPTURE ADMIN (12c and later)
- READ or SELECT on SYS.DBA USERS WITH DEFPWD
- READ ON SYS.DBA\_AUDIT\_MGMT\_CONFIG\_PARAMS
- READ on SYS.DBA CREDENTIALS



EXECUTE on SYS.DBMS SQL

#### Note:

If you plan to run only the Discoverer component, you can assign only the following privileges:

- CREATE SESSION
- Role select catalog role

In order to successfully collect Database Vault information in a Database Vault protected environment, you must connect as a non-SYS user with the DV SECANALYST role.

#### Sample Script to Create a User with Minimum Privileges

You can create a user with required minimum privileges to run the Oracle Database Security Assessment Tool Collector with a script.

#### Purpose

Create a DBSAT user to run the Oracle DBSAT Collector script with required privileges.

### Sample Script

```
create user dbsat_user identified by dbsat_user;
--If Database Vault is enabled, connect as DV_ACCTMGR to run this command
grant create session to dbsat_user;
grant select_catalog_role to dbsat_user;
grant select on sys.registry$history to dbsat_user;
grant read on sys.dba_audit_mgmt_config_params to dbsat_user;
grant select on sys.dba_users_with_defpwd to dbsat_user;
grant read on sys.dba_credentials to dbsat_user;
grant execute on sys.dbms_sql to dbsat_user;
grant audit_viewer to dbsat_user; // 12c and later
grant capture_admin to dbsat_user;// 12c and later covers
sys.dba_priv_captures, sys.priv_capture$, sys.capture_run_log$
--If Database Vault is enabled, connect as DV_OWNER to run this
command
grant DV SECANALYST to dbsat user;
```

## Reporter Prerequisites



The Reporter is a Java program and requires the Java Runtime Environment (JRE) 1.8 (jdk8-u172) or later to run.

### **Discoverer Prerequisites**

The Discoverer is a Java program and requires the Java Runtime Environment (JRE) 1.8 (jdk8-u172) or later to run.

The Discoverer collects metadata from database dictionary views and matches them against the patterns specified to discover sensitive data. The Discoverer must connect to the database as a user with sufficient privileges to select from these views. For more information about DBSAT user privileges, see Collector Prerequisites.



The Discoverer relies on table statistics to get row counts. In order to get accurate row count results, <code>DBMS\_STATS</code> should be executed by the Database Administrator before the DBSAT user runs the Discoverer.

# Installing the Oracle Database Security Assessment Tool

To install the Oracle DBSAT:

- Log in to the database server.
- 2. Create the dbsat directory:

```
mkdir -p /home/oracle/dbsat
```

3. Download or copy the dbsat.zip file to the database server, and unzip the file.

```
unzip dbsat.zip -d /home/oracle/dbsat Where -d refers to the directory path.
```

These commands are for Linux / Unix. If the installation takes place on Windows, you will use similar commands for Windows.

The Oracle DBSAT is installed on the database server.

You can run the Collector, Reporter, and Discoverer from the /home/oracle/dbsat directory.

You can also add this directory to your PATH and skip the step of going to the directory every time you want to run the tool.

## Using the Collector and Reporter



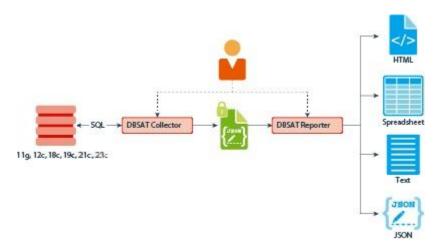
You can generate the Oracle Database Security Assessment Report and the Oracle Database Sensitive Data Assessment Report with the Collector, Reporter, and Discoverer components.

## **Oracle Database Security Assessment Report**

The Collector and Reporter components are used to generate the Oracle Database Security Assessment Report.

The following figure shows the components and architecture of the Collector and Reporter.

Figure Collector and Reporter Components and Architecture



## Running the Collector

The Collector queries the database to collect data that will be analyzed by the Reporter.



The Collector connects to the database. Ensure that the target database and listener are running before running the Collector.

To run the Collector, do the following:

1. Specify the arguments to run the Collector:

\$ dbsat collect <database\_connect\_string> <output\_file>

The dbsat collect command has the following options and arguments:



• database connect string

Specifies the connection string to connect to the database.

Example: system@ORCL

• output file

Specifies the location and file name for the Database Security Assessment report. Do not add an extension.

Example: /home/oracle/dbsat/output ORCL

#### 2. Run the Collector.

\$ ./dbsat collect system@ORCL output ORCL

#### The following output is displayed:

```
Connecting to the target Oracle database...
SQL*Plus: Release 19.0.0.0.0 - Mon Jan 30 10:19:15 2023
Version 19.13.0.0.0
Copyright (c) 1982, 2021, Oracle. All rights reserved.
Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 -
Production
Version 19.13.0.0.0
Setup complete.
SQL queries complete.
Warning: Exit status 256 from OS rule: dbcs status
OS commands complete.
Disconnected from Oracle Database 19c Enterprise Edition Release
19.0.0.0.0 - Production
Version 19.13.0.0.0
DBSAT Collector completed successfully.
Calling /u01/app/oracle/product/version/db 1/bin/zip to encrypt
output ORCL.json...
Enter password:
Verify password:
  adding: output ORCL.json (deflated 88%)
zip completed successfully.
```



#### Note:

DBSAT can display warnings informing that some checks were skipped. These can be safely ignored as the execution proceeds. Some reasons to skip checks include wrong permissions, missing .ora files, not applicable to that target type, and more. For details, please refer to My Oracle Support.

Running the Collector in the root container in a multitenant container database collects data specific to the root container and not from its pluggable databases. If you need to access specific pluggable databases, you must run the Collector for these pluggable databases separately.

If you do not want to encrypt the file invoke the  ${\tt dbsat}$  collect script with the  ${\tt -n}$  option. This is not recommended.

## Running the Reporter

The Reporter analyzes the data collected by the Collector and makes recommendations to improve the security of the database.

You can invoke the Reporter with dbsat report.

To run the Reporter, do the following:

Check that Java Runtime Environment (JRE) 1.8 (jdk8-u172) or later is installed.

```
$ java -version
```

A similar output is displayed:

```
java version "1.8.0 191"
```

2. Specify the arguments to run the Reporter.

```
\ dbsat report [-a] [-n] [-g] [-x <section>] [-u <user> ] <input file>
```

Where the argument <code>input\_file</code> stands for the full or relative path to the data file <code>output\_ORCL</code> produced by the Oracle DBSAT Collector. If this file was encrypted during data collection, you will need to supply the encryption password when prompted by the Reporter.

The Reporter supports the following command-line options:

• -a

Runs the report for all the database accounts including locked or schema only accounts that are Oracle-supplied.

-n

Specifies no encryption for output.



Note:

For security reasons, this is not recommended.

-q

Shows all grants including common grants in a pluggable database.

• -u

Specify users to exclude from report.

To exclude multiple users use a comma-separated list, for example: -u  ${\tt SCOTT}, {\tt DEBRA}$ 

• -X

Excludes a section from the report.

Valid sections are:

USER: User Accounts

PRIV: Privileges and Roles

AUTHZ: Authorization Control

ENCRYPT: Encryption

ACCESS: Fine-Grained Access Control

AUDIT: Auditing

CONF: Database Configuration

- NET: Network Configuration

OS: Operating System

To exclude multiple sections use a comma-separated list, for example:

```
-x USER, PRIV
```

Or:

-x USER -x PRIV

Omitting this option will include all sections of the report.

The same path name is used to generate the report files produced by the Reporter in HTML, Excel, JSON, and Text formats with the appropriate file extensions.

3. Run the Reporter.

```
$ ./dbsat report output ORCL
```

#### The following output appears:

```
Archive: output_ORCL.zip
[output_ORCL.zip] output_ORCL.json password:
  inflating: output_ORCL.json
```



4. Specify a password to encrypt the output report .zip file.

The .zip file is created.

#### Note:

The .zip file is used for Reporter and Discoverer output. To avoid confusion, it is recommended that you use the same password while creating both outputs.

5. Extract the contents of the .zip file to access the Oracle Database Security Assessment Report. When prompted, enter the password to decrypt the .zip file specified in Step 4.

The contents of the .zip file are extracted.

**6.** Use the appropriate tools to read the recommendations from the report files.

Example: Use vi on Linux to read the .txt files.

Example: Use a browser to display the .html files.

#### Note:

DBSAT recommendations do not adjust for individual applications. In cases where the application requirements differ from DBSAT, you will frequently have to accept the finding as-is, possibly mitigating the finding through some other control. Unless the risk is too high for you to accept, the application requirements should usually supersede the DBSAT recommendation.

## Oracle Database Security Assessment Report

The Collector and Reporter components are used to generate the Oracle Database Security Assessment (DBSAT) Report in HTML, Excel, JSON, and Text formats.

The HTML report provides detailed results of the assessment in a format that is easy to navigate. The Excel format provides a high-level summary of each finding without the detailed output included in the HTML report. It also allows you to add columns for your tracking and prioritization purposes. A report in text format makes it convenient to



copy portions of the output for other usages. Finally, a JSON document containing the report contents is provided for easier filtering, comparison, aggregation, and integration with other tools.

## Oracle Database Security Assessment Report — Summary

The Oracle Database Security Assessment Report — Summary section contains the following information:

Section	Description
Assessment Time & Date	Displays the date on which the data was collected and the date on which the final Database Security Assessment report was generated. The DBSAT Reporter version is also displayed.
Database Identity	Displays the details of the database assessed by DBSAT.
Summary	Displays a high level summary of the resulting analysis.

The following figure displays an example of the Oracle Database Security Assessment Report — Summary section.

#### Figure Oracle Database Security Assessment Report — Summary

#### Assessment Date & Time

Date of Data Collection	Date of Report	Reporter Version
Wed Jan 10 2024 16:10:47 UTC+00:00	Wed Jan 10 2024 16:13:17 UTC+00:00	3.1 (Jan 2024)

#### **Database Identity**

Name	Container (Type:ID)	Platform	Database Role	Log Mode	Created
CDB1	PDB1 (PDB:3)	Linux x86 64-bit	PRIMARY	NOARCHIVELOG	Wed Oct 30 2019 15:41:51 UTC+00:00

#### **Summary**

Section	Pass	Evaluate	Advisory	Low Risk	Medium Risk	High Risk	Total Findings
Basic Information	0	0	0	0	0	1	
User Accounts	6	10	1	5	2	0	24
Privileges and Roles	4	25	1	0	0	0	30
Authorization Control	0	3	2	0	0	0	!
Fine-Grained Access Control	0	1	4	0	0	0	
Auditing	6	8	2	0	0	0	16
Encryption	0	4	0	0	0	0	
Database Configuration	8	8	0	1	3	1	2
Network Configuration	1	0	3	1	0	0	
Operating System	2	4	0	1	2	0	,
Total	27	63	13	8	7	2	120

The Summary section is followed by the Basic Information section.

Oracle Database Security Assessment Report — Basic Information



The Oracle Database Security Assessment Report — Basic Information section contains the following information:

Section	Finding ID	Description
Databas e Version	-	Displays the version of the database assessed by the Collector and Reporter.
Security Features Utilized	-	Displays the security features and indicates if they are in use.
Patch INFO.PAT		Displays information about the patches installed.
Check	CH	It is vital to keep the database software up-to-date with security fixes as they are released. Oracle issues comprehensive patches in the form of Release Updates on a regular quarterly schedule. Patch Set Updates and Bundle Patches were available for database versions up to 12.1.0.2.

The following figure displays an example of the Oracle Database Security Assessment Report — Basic Information section.

Figure Oracle Database Security Assessment Report — Basic Information



## **Basic Information**

#### **Database Version**

Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production Version 19.19.0.0.0 Security options used: (none)

#### Security Features Utilized

Feature	<b>Currently Used</b>
USER AUTHENTICATION	
Password Authentication	Yes
Global Authentication	No
External Authentication	No
AUTHORIZATION CONTROL	
Database Vault	No
<b>Database Vault Operations Control</b>	No
Privilege Analysis	No
FINE-GRAINED ACCESS CONTROL	
Virtual Private Database	No
Real Application Security	No
Label Security	No
Data Redaction	No
Transparent Sensitive Data Protection	No
AUDITING	
Unified Audit	Yes
Fine Grained Audit	No
Traditional Audit	N/A
ENCRYPTION	
Tablespace Encryption	No
Column Encryption	No
Network Encryption	No

The Basic Information section is followed by the User Accounts section.

## Oracle Database Security Assessment Report — User Accounts

The Oracle Database Security Assessment Report — User Accounts section displays the following information:



Name	Finding ID	Description
User Accounts		Displays the user accounts and the following information about each account:
	<u>-</u>	<ul> <li>User Name — Displays the name of the user.</li> <li>Profile — Displays the profile assigned to the account.</li> <li>Status — Displays whether the account is, for example, Open, Locked, Expired, or in</li> </ul>
		<ul> <li>Rollover.</li> <li>Authentication Type — Displays the type of authentication used.</li> </ul>
		<ul> <li>Default Tablespace — Displays the default tablespace for the account.</li> </ul>
		<ul> <li>Oracle Defined — Displays whether the user account is oracle maintained or not.</li> </ul>
Users with DEFAULT Profile	USER.DE FAULTPR OFILE	Displays the DEFAULT user profile password and resource parameters and the number of users in it.
Users with Default Passwords	USER.DE FPWD	Displays information about the user accounts with default passwords.
		Default account passwords for predefined Oracle accounts are well known. Active accounts with default passwords provide a trivial means of entry for attackers, but well-known passwords should be changed for locked accounts as well.
Users with Expired Passwords	USER.EX PIRED	Displays information about the user accounts with expired passwords.
		Password expiration is used to ensure that users change their passwords regularly. Unlocked accounts with an expired password can present a security risk, especially as those accounts age. Although the password is expired, because the account is unlocked, it can easily be used by anyone who knows the old password. You should investigate accounts that have been unused for an extended period to determine whether they should remain active.
Inactive Users	USER.IN ACTIVE	Displays information about the user accounts that are not in use and also accounts that are not configured to be locked when inactive.
		If a user account is no longer in use, it increases the attack surface of the system unnecessarily while providing no corresponding benefit. Furthermore, unauthorized use is less likely to be noticed when no one is regularly using the account. Accounts that have been unused for more than 30 days should be investigated to determine whether they should remain active. A solution is to set INACTIVE_ACCOUNT_TIME in the profiles assigned to users.



Name	Finding ID	Description
Sample Schemas	USER.SA MPLE	Displays information about the user accounts that use sample schemas such as SCOTT, HR, OE, SH, PM, IX, ADAMS, BLAKE, CLARK, and BI.
		Sample schemas are well-known accounts provided by Oracle to serve as simple examples for developers. They generally serve no purpose in a production database and should be removed because they unnecessarily increase the attack surface of the database.
Application Owner Account	USER.AP POWNER	Checks the database for the account that could be considered the application owner and for objects accessible by the application owner. Any user not "oracle maintained" that owns most objects in the database is considered the Application Owner. This check:  Lists application owners  Lists users who can login into database  Lists app owners and the objects owned by it along with the non-app owners who can access those objects
Shared Accounts	USER.SH ARED	Displays users that have multiple administrative privileges and proxy users.
Users with Objects	USER.OB JOWNER	Displays application users who own objects and can grant access to those objects to other users
Users Authorized for Object Ownership	USER.OB JAUTHZ	Displays non-oracle maintained users who own objects
Users with Security Objects	USER.SE CURITYO BJS	Displays users who own security objects
Users with Grant Option	USER.GR ANTOPTI ON	Checks for users that have been granted privileges with WITH GRANT OPTION.
Users with Sensitive Data	USER.SE NSITVED ATA	Displays users that own tables with columns marked as sensitive with TSDP and users that can access those tables.
		To ensure secure access to sensitive information, review these users. It is best to grant access to data through roles rather than directly to individua accounts.



Name	Finding ID	Description
User Schemas in SYSTEM or SYSAUX Tablespace	USER.TA BLESPAC E	Displays information about the regular user accounts that use the reserved Oracle-supplied tablespaces.
		The SYSTEM and SYSAUX tablespaces are reserved for Oracle-supplied user accounts. To avoid a possible denial of service caused by exhausting these resources, regular user accounts should not use these tablespaces. Prior to Oracle Database 12.2, the SYSTEM tablespace cannot be encrypted, and this is another reason to avoid user schemas in this tablespace.
Case-Sensitive Passwords	USER.PA SSWORD	Displays whether case-sensitive passwords are enabled.
	CASE	Case-sensitive passwords are recommended because including both upper and lower-case letters greatly increases the set of possible passwords that must be searched by an attacker who is attempting to guess a password by exhaustive search. Setting SEC_CASE_SENSITIVE_LOGON to TRUE ensures that the database distinguishes between upper and lower-case letters in passwords.



In 21c
USER.PASS
WORDCAS
E isn't
expected to
be shown as
SEC\_CASE\_S
ENSITIVE\_L
OGON is
desupported



Name	Finding ID	Description
Legacy Password Versions	THLEGAC	Displays information about the user accounts with obsolete password verifiers.
	Y	For each user account, the database may store multiple verifiers, which are hashes of the user password. Each verifier supports a different version of the password authentication algorithm. Every user account should include a verifier for the latest password version supported by the database so that the user can be authenticated using the latest algorithm supported by the client. When all clients have been updated, the security of user accounts can be improved by removing the obsolete verifiers. HTTP password verifiers are used for XML Database authentication. Use the ALTER USER command to remove these verifiers from user accounts that do not require this access.
User Profiles	-	Displays information about the user profiles.
Users with no Password Complexity Requirements	USER.PA SSWORD FUNCTIO N	Displays information about profiles with and without a password complexity verification function. Users not subject to password complexity verification are also displayed.
		Password verification functions are used to ensure that user passwords meet minimum requirements for complexity, which may include factors such as length, use of numbers or punctuation characters, difference from previous passwords, etc. Oracle supplies several predefined functions, or a custom PL/SQL function can be used. Every user profile should include a password verification function.
Account Locking after Failed Login Attempts	USER.NO LOCK	Displays information about user profile failed login attempt enforcement.
		Attackers sometimes attempt to guess a user's password by simply trying all possibilities from a set of common passwords. To defend against this attack, it is advisable to use the FAILED_LOGIN_ATTEMPTS and PASSWORD_LOCK_TIME profile resources to lock user accounts for a specified time when there are multiple failed login attempts without a successful login.



Name	Finding ID	Description
Users with Unlimited Password Lifetime	USER.NO EXPIRE	Displays information about user profile password expiration enforcement.
		Password expiration is used to ensure that users change their passwords on a regular basis. It also provides a mechanism to automatically disable temporary accounts. Passwords that never expire may remain unchanged for an extended period of time. When passwords do not have to be changed regularly, users are also more likely to use the same passwords for multiple accounts.
Users with Unlimited Concurrent Sessions	USER.SE SSIONS	Displays all users that have a Profile Resource Limit for SESSIONS_PER_USER set to UNLIMITED. With SESSIONS_PER_USER = UNLIMITED users can have any number of concurrent sessions.
Unlimited Session Idle Time	USER.IDL ETIME	This check lists users with UNLIMITED IDLE TIME
Users with Gradual Password Rollover	USER.PA SSWORD ROLLOVE R	Rollover.  Gradual Password Rollover allows administrators to change database passwords for applications without having to schedule downtime. Prior to the advent of the gradual password rollover feature, the database administrator needed to take the application down while the database password was being rotated. This was because the password update required changes on both the database and the application side. With gradual database password rollover, the application can continue to use the older password until the new password is configured in the application. To accomplish this, the database administrator can associate a profile having a non-zero limit for the PASSWORD_ROLLOVER_TIME password profile parameter with an application schema. This allows the database password of the application user to be altered while allowing the older password to remain valid for the time specified by the PASSWORD_ROLLOVER_TIME limit. Try to limit the use of this feature to application schemas that
Temporary Users	USER.TE MP	need to undergo password maintenance and keep the rollover period to the minimum.  Displays users associated with the DEFAULT profile.  Users specifically created to execute temporary tasks should be on a profile tailored for that purpose.
Development Users in Production Databases	USER.DE V	



Name	Finding ID	Description
Advanced Replication Users	USER.RE PCAT	Checks if Oracle Advanced Replication is being used and lists the dblinks used for replication.  Checks to see if enable_goldengate_replication is set to TRUE. Also checks if DBA_REPCAT% views are present or count(*) from DBA_REPCATLOG > 0.
Minimum Client Authentication Version	USER.AU THVERSI ON	1 -7
		sqlnet.ora parameter ALLOWED_LOGON_VERSION_SERVER determines the minimum password version that the database will accept. For maximum security, this parameter should be set to the highest value supported by the database once all client systems have been upgraded.

#### Note:

Predefined Oracle accounts which are schema-only or locked are not included in this report. To include all user accounts, run the report with the -a option.

The following figure displays an example of the Oracle Database Security Assessment Report — User Accounts section.



Figure Oracle Database Security Assessment Report — User Accounts

#### **User Accounts**

User Name	Profile	Status	<b>Authentication Type</b>	<b>Default Tablespace</b>	<b>Oracle Defined</b>
APPDEV_USER1	DEFAULT	OPEN	PASSWORD	USERS	No
APPDEV_USER2	DEFAULT	OPEN	PASSWORD	USERS	No
APPDEV_USER3	DEFAULT	OPEN	PASSWORD	USERS	No
AVAUDITUSER	DEFAULT	OPEN	PASSWORD	USERS	No
BACKUP_ADMIN	DEFAULT	OPEN	PASSWORD	USERS	No
BA_BETTY	DEFAULT	OPEN	PASSWORD	USERS	No
C##DBA_DAVE	DEFAULT	OPEN	PASSWORD	USERS	No
C##DVACCTMGR	DEFAULT	OPEN	PASSWORD	USERS	No
C##DVACCTMGR_BACKUP	DEFAULT	OPEN	PASSWORD	USERS	No
C##DVOWNER	DEFAULT	OPEN	PASSWORD	USERS	No
C##DVOWNER_BACKUP	DEFAULT	OPEN	PASSWORD	USERS	No
C##KEYMASTER	DEFAULT	OPEN	PASSWORD	USERS	No
C##SEC_DBA_SAL	DEFAULT	OPEN	PASSWORD	USERS	No
C##ZEUS	DEFAULT	OPEN	PASSWORD	USERS	No
DBA_DEBRA	DEFAULT	OPEN	PASSWORD	USERS	No

The User Accounts section is followed by the Privileges and Roles section.

# Oracle Database Security Assessment Report — Privileges and Roles

The Oracle Database Security Assessment Report — Privileges and Roles section displays the following information:

Name	Finding ID	Description
Access to Password Verifier Tables	PRIV.AC CESSVE RIFIERS	Displays access to password verifier tables granted to users.
		Users with these privileges can access objects that contain user password verifiers. The verifiers can be used in offline attacks to discover user passwords.
Users with Administrative Privileges SYS*	PRIV.SYS ADMIN	Displays the administrative privileges granted to user accounts.
Privileges		Administrative privileges allow a user to perform maintenance operations, including some that may occur while the database is not open. The SYSDBA privilege allows the user to run as SYS and perform virtually all privileged operations. Starting with Oracle Database 12.1, less powerful administrative privileges were introduced to allow users to perform common administrative tasks with less than full SYSDBA privileges. To achieve the benefit of this separation of duty, each of these administrative privileges should be granted to at least one user account.



Name	Finding ID	Description
Users with DBA Role	PRIV.DBA	Displays the user accounts that have been granted the DBA or PDB_DBA role.
		The DBA role is very powerful and can be used to bypass many security protections. It should be granted to only a small number of trusted administrators. Furthermore, each trusted user should have an individual account for accountability reasons. As with any powerful role, avoid granting the DBA role with admin option unless absolutely necessary.
Users with Powerful Roles	PRIV.BIG ROLES	Displays the user accounts that have been granted roles with maximum data access privileges.
		Like the DBA role, these roles (AQ_ADMINISTRATOR_ROLE, EM_EXPRESS_ALL, EXP_FULL_DATABASE, IMP_FULL_DATABASE, SELECT_CATALOG_ROLE, EXECUTE_CATALOG_ROLE, DELETE_CATALOG_ROLE, OEM_MONITOR) contain powerful privileges that can be used to bypass security protections. They should be granted only to a small number of trusted administrators.
System Privilege Grants	PRIV.SYS	Displays the system privileges granted to users.
	TEM	System privileges provide the ability to access data or perform administrative operations for the entire database. Consistent with the principle of least privilege, these privileges should be granted sparingly. System privileges should be granted with admin option only when the recipient needs the ability to grant the privilege to others.
		$-g$ option reports all grants including common grants in a PDB. The report displays $({}^\star)$ for privileges being granted with admin option, $({\mathbb D})$ for privileges being granted directly, and $({\mathbb C})$ for privileges being granted commonly.
System Privileges	PRIV.SYS	Displays the system privileges granted to PUBLIC.
Granted to PUBLIC	PUBLIC	Privileges granted to PUBLIC are available to all users. This generally should include few, if any, system privileges since these will not be needed by ordinary users who are not administrators.
Roles Granted to	PRIV.ROL	Displays the roles granted to PUBLIC.
PUBLIC	EPUBLIC	Roles granted to ${\tt PUBLIC}$ are available to all users. Most roles contain privileges that are not appropriate for all users.
Column Privileges Granted to PUBLIC	PRIV.COL PUBLIC	Displays the column access privileges granted to PUBLIC.
		Privileges granted to PUBLIC are available to all users. This should include column privileges only for data that is intended to be accessible to everyone.



Name	Finding ID	Description
Objects Accessible by PUBLIC	PRIV.OBJ PUBLIC	Displays objects that are accessible by PUBLIC.
Encryption Packages Granted to PUBLIC	PRIV.EN CRYPTP ACKAGE PUBLIC	Displays DBMS_CRYPTO, DBMS_OBFUSCATION_TOOLKIT, and DBMS_RANDOM grants to PUBLIC.
Scheduler Job Packages Granted to PUBLIC	PRIV.JOB SCHPAC KAGEPU BLIC	Display DBMS_SCHEDULER and DBMS_JOB EXECUTE grants to PUBLIC and Scheduler/Job system privileges (CREATE JOB, MANAGE SCHEDULER, CREATE EXTERNAL JOB, CREATE ANY JOB) grants to PUBLIC.
Credential Package Granted to PUBLIC	PRIV.CR EDPACK AGEPUB LIC	Displays EXECUTE grant on DBMS_CREDENTIAL package to PUBLIC. Also checks for privilege grants of CREATE CREDENTIAL and CREATE ANY CREDENTIAL to users.
File System Packages Granted to PUBLIC	PRIV.FIL ESYSTE MPACKA GEPUBLI C	Displays EXECUTE grant on DBMS_LOB, UTL_FILE, and DBMS_ADVISOR packages to PUBLIC. Also checks for system privilege grants of CREATE ANY DIRECTORY and DROP ANY DIRECTORY to users.
Network Packages Granted to PUBLIC	PRIV.NET PACKAG EPUBLIC	Displays EXECUTE grant on DBMS_LDAP, UTL_HTTP, UTL_INADDR, UTL_SMTP, and UTL_TCP packages to PUBLIC. Also checks for users that are authorized to execute packages via ACLs.
SQL Packages Granted to PUBLIC	PRIV.QU ERYPAC KAGEPU BLIC	Displays EXECUTE grant on DBMS_XMLQUERY, DBMS_XMLSAVE, DBMS_XMLSTORE, DBMS_REDACT, DBMS_XMLGEN, and DBMS_SQL packages to PUBLIC.
JAVA Permissions Granted to PUBLIC	PRIV.JAV APACKA GEPUBLI C	Displays EXECUTE grant on DBMS_JAVA and DBMS_JAVA_TEST packages to PUBLIC. Also checks for grants of JAVA_ADMIN role to users.
All Roles	PRIV.ALL	Displays all roles granted to users.
	ROLES	Roles are a convenient way to manage groups of related privileges, especially when the privileges are required for a particular task or job function. Beware of broadly defined roles, which may confer more privileges than an individual recipient requires. Roles should be granted with admin option only when the recipient needs the ability to modify the role or grant it to others.
Account Management Privileges	PRIV.AC COUNTM	Displays account management privileges granted to users.
	GMT	User management privileges (ALTER USER, CREATE USER, DROP USER) can be used to create and modify other user accounts, including changing passwords. This power can be abused to gain access to another user's account, which may have greater privileges.



Name	Finding ID	Description
Role and Privilege Management Privileges	PRIV.ROL EPRIVM GMT	Displays privilege management privileges granted to users.
		Users with privilege management privileges (ALTER ANY ROLE, CREATE ROLE, DROP ANY ROLE, GRANT ANY OBJECT PRIVILEGE, GRANT ANY PRIVILEGE, GRANT ANY ROLE) can change the set of privileges granted to themselves and other users. This ability should be granted sparingly, since it can be used to circumvent many security controls in the database.
Database Management Privileges	PRIV.DB MGMT	Displays database management privileges granted to users.
		Database management privileges (ALTER DATABASE, ALTER SYSTEM, CREATE ANY LIBRARY, CREATE LIBRARY) can be used to change the operation of the database and potentially bypass security protections. This ability should be granted only to trusted administrators.
Audit Management Package	PRIV.AU DITMGM TPKG	Displays audit management tool access granted to users.  The DRMS AUDIT MOME package allow for execution of
		The DBMS_AUDIT_MGMT package allow for execution of Audit management tools. Access should be strictly limited and granted only to users with a legitimate need for this functionality.
Audit Management Privileges	PRIV.AU DITMGM T	Displays audit management privileges granted to users. Audit management privileges (AUDIT ANY, AUDIT SYSTEM) can be used to change the audit policies for the database. This ability should be granted sparingly, since it may be used to hide malicious activity.
Access to Audit Objects	PRIV.AC	Displays access to audit objects granted to users.
·	CESSAU DITOBJ	Users with these privileges can directly access and modify objects containing audit information. Access to these objects may allow a malicious user deduce privilege settings for other users and to manipulate the audit information by replacing or deleting audit records.
Access Control Exemption Privileges	PRIV.AC CESSEX EMPT	Displays access control exemption privileges that are enforced.  Users with exemption privileges (EXEMPT ACCESS POLICY, EXEMPT REDACTION POLICY) can bypass the row and column access control policies enforced by Virtual Private Database and Data Redaction. Most administrative tasks do not require access to the data itself, so these privileges should be granted rarely even to administrators.

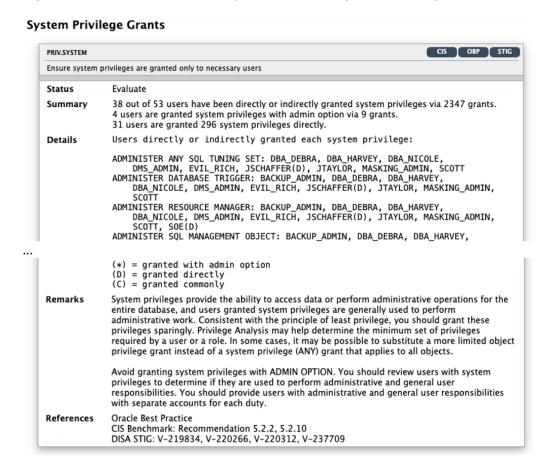


Name	Finding ID	Description
Write Access to Restricted Objects	PRIV.RES TRICTED OBJ	Displays access to restricted objects granted to users.  Users with these privileges can directly modify objects in the SYS, DVSYS, AUDSYS or LBACSYS schemas.  Manipulating these system objects may allow security protections to be circumvented or otherwise interfere with normal operation of the database. Object permissions granted to PUBLIC must be restricted for objects in the SYS, DVSYS, AUDSYS or LBACSYS schemas.
Users Who Can Impersonate Other Users	PRIV.IMP ERSONA TEUSER	Displays the user accounts that have been granted rights to impersonate other users.  The BECOME USER privilege and these PL/SQL packages (DBMS_AQADM_SYS, DBMS_AQADM_SYSCALLS, DBMS_IJOB, DBMS_PRVTAQIM, DBMS_REPCAT_SQL_UTL, DBMS_SCHEDULER, DBMS_STREAMS_ADM_UTL, DBMS_STREAMS_RPC, DBMS_SYS_SQL, INITJVMAUX, LTADM, WWV_DBMS_SQL, WWV_EXECUTE_IMMEDIATE) allow for execution of SQL code or external jobs using the identity of a different user. Access should be strictly limited and granted only to users with a legitimate need for this functionality.
Privilege for Data Exfiltration in Bulk	PRIV.EXF ILTRATIO N	Displays the user accounts that have been granted rights to access or copy any data from a client or server. These PL/SQL packages (DBMS_BACKUP_RESTORE, UTL_DBWS, UTL_ORAMTS) can send data from the database using the network or file system. Access should be granted only to users with a legitimate need for this functionality.
Code Based Access Control	PRIV.CBA C	Displays all program units granted CBAC roles.  Code Based Access Control(CBAC) can be used to grant additional privileges on program units. CBAC allows you to attach database roles to a PL/SQL function, procedure, or package. These database roles are enabled at run time, enabling the program unit to execute with the required privileges in the calling user's environment.
Java Permissions	PRIV.JAV APERMIS SIONS	Displays the user accounts that have been granted privileges to execute Java classes within the database. Java permission grants control the ability of database users to execute Java classes within the database server. A database user executing Java code must have both Java security permissions and database privileges to access resources within the database. These resources include database resources, such as tables and PL/SQL packages, operating system resources, such as files and sockets, Oracle JVM classes, and user-loaded classes. Make sure that these permissions are limited to the minimum required by each user.



The following figure displays an example of the Oracle Database Security Assessment Report — Privileges and Roles section.

#### Figure Oracle Database Security Assessment Report — Privileges and Roles



The Privileges and Roles section is followed by the Authorization Control section.

# Oracle Database Security Assessment Report — Authorization Control

The Oracle Database Security Assessment Report — Authorization Control section displays the following information:

Name	Finding ID	Description
Database Vault		Displays whether Oracle Database Vault is enabled and details existing protected objects, realms, command rules, and users granted Database Vault specific roles.
		Database Vault provides for configurable policies to control the actions of database accounts with elevated privileges such as those accounts used by administrative users, applications and utilities. Attacks (originating from external as well as internal sources) leverage privileged account credentials to access sensitive information. Database Vault realms prevent unauthorized access to sensitive data objects, even by user accounts with system privileges. Database Vault Command rules limit the accidental or malicious execution of SQL commands. You can use Database Vault to enforce separation of duties to prevent a single all powerful user. Also it provides trusted paths to further restrict access to sensitive data using system factors such as IP address, program name, time of day and user name. Database Vault operations control can be used to restrict common users from accessing pluggable database (PDB) local data in autonomous, regular Cloud, or on-premises environments.
Privilege Analysis		Displays Privilege Analysis policies and users with privileges to start the capture proces.
	YSIS	Privilege Analysis records the privileges used during a real or simulated workload. After collecting data about the privileges that are actually used, this information can be used to revoke privilege grants that are no longer needed or to create roles with only the privileges that are used by the user or role. This helps implement Least Privilege Model and minimizes risk from intentional or accidental abuse of privileges.
Authenticatio n for Client Scripts	AUTHZ.P ASSWO RDSCRI PTS	Lists password-authenticated users whose passwords can potentially be embedded in client scripts, jobs, and application source code to connect to the database server.
Data Masking	AUTHZ.D ATAMAS	Lists tables with sensitive data that should be masked when transferred to non-production systems.
	KING	This check lists tables marked sensitive by TSDP or in DBA_TABLES and users that can transfer data via DATAPUMP_EXP_FULL_DATABASE or DATAPUMP_IMP_FULL_DATABASE.
PKI Based Authenticatio n	AUTHZ.P KI	List user accounts identified externally where the authentication method is TCPS. This finding is targeting mostly customers looking for STIG compliance.

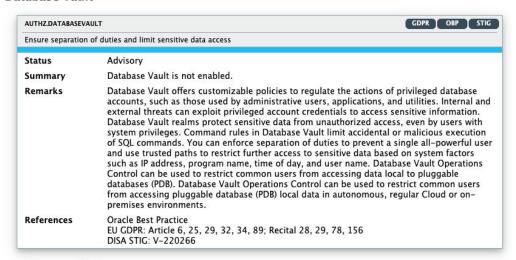
The following figure displays an example of the Oracle Database Security Assessment Report — Authorization Control section.



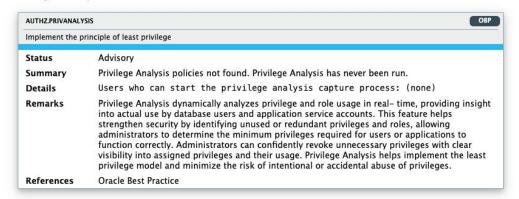
#### Figure Oracle Database Security Assessment Report — Authorization Control

#### **Authorization Control**

#### **Database Vault**



#### **Privilege Analysis**



The Authorization Control section is followed by the Fine-Grained Access Control section.

# Oracle Database Security Assessment Report — Fine-Grained Access Control

The Oracle Database Security Assessment Report — Fine-Grained Access Control section displays the following information:



Name	Finding ID	Description
Data Redaction	ACCESS.D ATAREDAC TION	Displays information on Data Redaction policies, exempted users, and execute grants on the DBMS_REDACT package.
		Data Redaction automatically masks sensitive data found in the results of a database query.
Virtual Private Database	ACCESS.V PD	Displays information on Virtual Private Database policies, exempted users, and execute grants on the DBMS_RLS package.
		VPD allows for fine-grained control over the rows and columns of a table are visible to a SQL statement.
Real Application Security	ACCESS.R AS	Displays information on Real Application Security policies, exempted users, and users granted ADMIN_SEC_POLICY and APPLY_SEC_POLICY.
		Real Application Security (RAS) is a more modern, advanced version of Virtual Private Database and provides fine-grained control over the rows and columns of a table that are visible to a SQL statement.
Label Security	ACCESS.L	Displays whether Oracle Label Security is enabled.
	ABELSEC URITY	Oracle Label Security provides the ability to tag data with a data label or a data classification. Access to sensitive data is controlled by comparing the data label with the requesting user's label or security clearance.
Transparent Sensitive Data Protection	ACCESS.T SDP	Displays information on Transparent Sensitive Data policies and the users that can manage it.
		TSDP was introduced in Oracle Database 12.1, and allows a data type to be associated with each column that contains sensitive data. TSDP can then apply various data security features to all instances of a particular type so that protection is uniform and consistent.

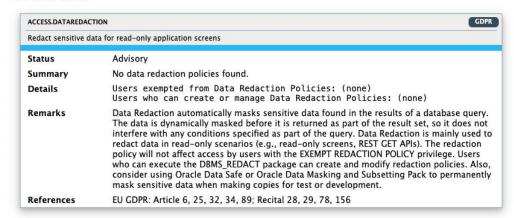
The following figure displays an example of the OracleDatabase Security Assessment Report — Fine-Grained Access Control section.



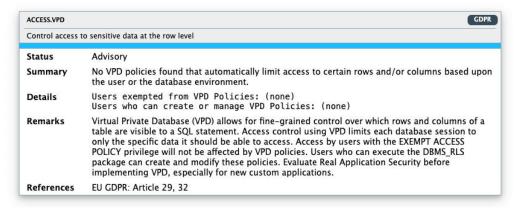
## Figure Oracle Database Security Assessment Report — Fine-Grained Access Control

#### **Fine-Grained Access Control**

#### **Data Redaction**



#### Virtual Private Database



The Fine-Grained Access Control section is followed by the Auditing section.

## Oracle Database Security Assessment Report — Auditing

The Oracle Database Security Assessment Report — Auditing section displays the following information:

Name	Finding ID	Description
Audit Management Configuration	-	Displays information on audit management configuration parameters
Parameters		



Name	Finding ID	Description
Audit Records	AUDIT.ENA BLED	Displays information about audit trails.
		Auditing is an essential component for securing any system. The audit trail allows for monitoring the activities of highly privileged users.
Unified Audit	AUDIT.UNI	Displays whether unified audit policies are enabled.
Policies	FIEDPOLIC IES	Unified Audit, available in Oracle Database 12.1 and later releases, combines multiple audit trails into a single unified view. It also introduces new syntax for specifying effective audit policies.
Fine Grained Audit	AUDIT.FGA	Displays whether fine grained audit policies are enabled.
		Fine Grained Audit policies can record highly specific activity, such as access to particular table columns or access that occurs under specified conditions. This is a useful way to monitor unexpected data access while avoiding unnecessary audit records that correspond to normal activity.
Audit Administrative		Displays whether the actions of the SYS user are audited by enabled audit policies.
(SYS*) Users		It is important to audit administrative actions performed by the SYS user. Traditional audit policies do not apply to SYS, so the AUDIT_SYS_OPERATIONS parameter must be set to record SYS actions to a separate audit trail.
Audit User Logon and Logoff	AUDIT.CON NECTIONS	Displays whether Database connections are audited by enabled audit policies.
		Successful user connections to the database should be audited to assist with future forensic analysis. Unsuccessful connection attempts can provide early warning of an attacker's attempt to gain access to the database.
Audit Database Management	AUDIT.DBM GMT	Displays whether the actions related to database management are audited by enabled audit policies.
Activities		Actions that affect the management of database features should always be audited. Each action or privilege listed should be included in at least one enabled audit policy.
Audit Account Management Activities	AUDIT.ACC OUNTMGM T	Displays whether account management activities are audited.
Audit System Privileges	AUDIT.SYS TEMPRIVS	Displays information on whether system privileges are audited by enabled audit policies.
Audit Roles with System Privileges	AUDIT.ROL ESYSTEM PRIVS	Displays information about unified audit policies that audit roles with system privileges.
Audit Privilege Management	AUDIT.PRI VMGMT	Displays whether the actions related to privilege management are audited by enabled audit policies.
		Granting additional privileges to users or roles potentially affects most security protections and should be audited. Each action or privilege listed should be included in at least one enabled audit policy.



Name	Finding ID	Description
Audit SQL Statements	AUDIT.STAT EMENT	Displays information about SQL statements audited by enabled audit policies. Applies to targets with Traditional Auditing policies.
Audit Object Actions	AUDIT.SEN SITIVEOBJ S	Displays information about the object access audited by enabled audit policies.
Audit Synonym Management Activities	AUDIT.SYN ONYMS	Displays information on whether synonym management activities (CREATE ANY SYNONYM, CREATE PUBLIC SYNONYM, CREATE SYNONYM, DROP PUBLIC SYNONYM, DROP SYNONYM) are audited.
Audit Conditions	AUDIT.CON DITION	Lists all audit policies with conditions and, if enabled, lists users/roles it's enabled for.
Audit Shared Accounts	AUDIT.SHA REDPROX Y	Checks to see if users listed in USER.SHARED are being audited.
Audit Storage	AUDIT.TAB LESPACE	Displays information about tablespaces used by different audit trails. Checks include:  • Audit trail is SYSTEM  • Audit trail is SYSAUX  • Tablespace is non-autoextensible & 80% or more full (MEDIUM)  • Tablespace is non-autoextensible & 90% or more full (HIGH)
Audit Trail Cleanup	AUDIT.CLE ANUPJOBS	Lists enabled jobs that cleanup audit trails and checks cleanup jobs that are not present
Audit Data Pump	AUDIT.DAT APUMP	Displays whether data pump exports and imports are being audited.
Audit STIG Actions	AUDIT.STI GPOLICY	Oracle provides out-of-the-box audit policies that aim to answer DoD- auditable events requirements - ORA_STIG_RECOMMENDATIONS, ORA_ALL_TOPLEVEL_ACTIONS and ORA_LOGON_LOGOFF. This check will validate if these policies are audited.
Audit Database Vault	AUDIT.DAT ABASEVAU LT	Displays users that can administer Database Vault but are not audited and lists policies enabled to audit Database Vault actions
Audit Oracle Label Security	AUDIT.LAB ELSECURI TY	Displays information regarding enabled audit policies used to audit OLS.  Checks to see if Oracle Label Security (OLS) is enabled and no audit policy is found with OLS action  Reports if OLS is enabled and audit policies were found for OLS actions

### Note:

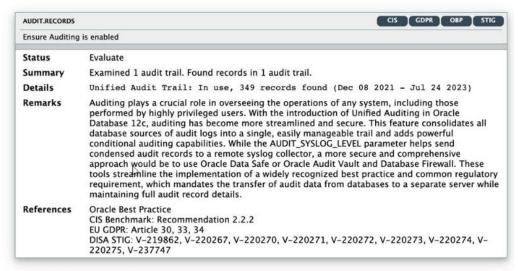
The details of the audit findings can vary depending on whether the database has unified audit or traditional audit in place. Starting in Oracle Database 12.2, the best practice is to use Unified Audit.



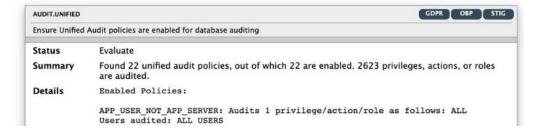
The following figure displays an example of the Oracle Database Security Assessment Report — Auditing section.

#### Figure Oracle Database Security Assessment Report — Auditing

#### **Audit Records**



#### **Unified Audit Policies**



The Auditing section is followed by the Encryption section.

## Oracle Database Security Assessment Report — Encryption

The Oracle Database Security Assessment Report — Encryption section displays the following information:



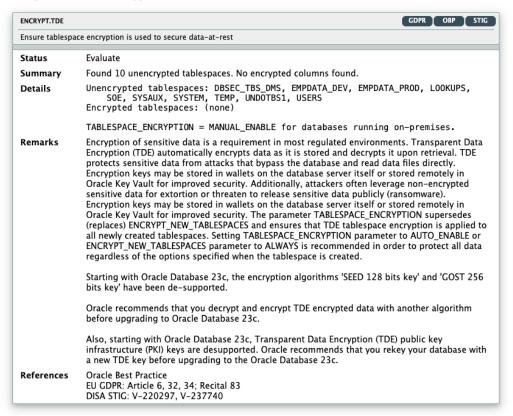
Name	Finding ID	Description
Transparent Data Encryption	ENCRYP T.TDE	Displays whether column or tablespace encryption is in use. Also, shows encrypted and unencrypted tablespaces along with the number of days since the master encryption key was last rotated.
		Encryption of sensitive data is a requirement in most regulated environments. Transparent Data Encryption automatically encrypts data as it is stored and decrypts it upon retrieval. This protects sensitive data from attacks that bypass the database and read data files directly.
Encryption Key	ENCRYP	Displays wallet information.
Wallet	T.WALLE T	Wallets are encrypted files used to store encryption keys, passwords, and other sensitive data. Wallet files should not be stored in the same directory with database data files, to avoid accidentally creating backups that include both encrypted data files and the wallet containing the master key protecting those files. For maximum separation of keys and data, consider storing encryption keys in Oracle Key Vault instead of wallet files.
FIPS Mode for TDE and	ENCRYP T.DBFIPS	Displays information whether TDE and DBMS_CRYPTYO run in a FIPS-compliant mode.
DBMS_CRYPTO		Federal Information Processing Standard (140-2) is a U.S. government security standard that specifies security requirements. It is used to approve cryptographic modules. Setting parameter DBFIPS_140 = TRUE enables Transparent Data Encryption (TDE) and DBMS_CRYPTO PL/SQL package program units to run in a FIPS-compliant mode. FIPS mode is mostly used by departments and agencies of the United States federal government looking to meet FIPS and/or STIG compliance. Be aware that this setting and thus using the underlying FIPS-certified library incurs a slight amount of overhead when the library is first loaded. This is due to the verification of the library signature and the execution of the self-test.
FIPS mode for TLS	ENCRYP T.TLSFIP S	Federal Information Processing Standard (140-2) is a U.S. government security standard that specifies security requirements. The SSLFIPS_140 parameter configures the Transport Layer Security (TLS) adapter to run in FIPS mode. SSLFIPS_LIB sets the location of the FIPS library.

The following figure displays an example of the Oracle Database Security Assessment Report — Encryption section.

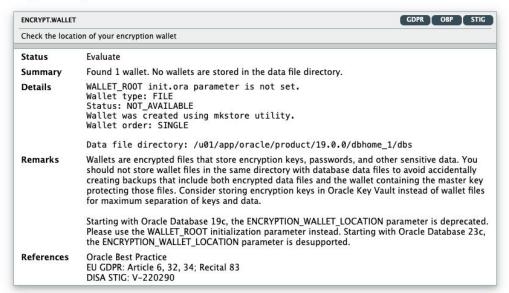


# Figure Oracle Database Security Assessment Report — Encryption and Encryption Key Wallets

#### Transparent Data Encryption



#### **Encryption Key Wallet**





The Encryption section is followed by the Database Configuration section.

# Oracle Database Security Assessment Report — Database Configuration

The Oracle Database Security Assessment Report — Database Configuration section displays the following information:

Name	Finding ID	Description	
Initialization Parameters for Security	-	Displays security related Database initialization parameters and their values.	
Pre-Authenticated Request URL		Displays pre-authenticated URL information for Autonomous Database Serverless databases including who can manage them via the DBMS_DATA_ACCESS package.	
Authentication Configuration	CONF.AU THN	Displays information about the user account initialization parameters.	
		SEC_MAX_FAILED_LOGIN_ATTEMPTS configures the maximum number of failed login attempts in a single session before the connection is closed. This is independent of the user profile parameter FAILED_LOGIN_ATTEMPTS, which controls locking the user account after multiple failed login attempts.  RESOURCE_LIMIT should be set to TRUE to enable enforcement of any resource constraints set in user profiles.	
PDB OS User		Checks if the highly privileged Oracle OS user is set for the PDB_OS_CREDENTIAL parameter.	
Control Files		Checks if control files are multiplexed and lists all the control file locations.	
	LES	The REMOTE_LOGIN_PASSWORDFILE set to EXCLUSIVE, allows passwords to be updated using the ALTER USER command.	
PDB OS User	CONF.DE FAULTPD BOSUSE R		
Redo Log Files	CONF.RE DOLOGS	Checks if the defined redo log files follow best practices and lists their location. Redo logs should be multiplexed and stored on different physical disks.	



Name	Finding ID	Description
Archive Log Mode		Checks if the database is in ARCHIVELOG or NOARCHIVELOG mode. If set, also displays the archive_log_destination or the recovery_file_destination. Also displays the archive_log_destination or the recovery_file_destination for the standalone databases.
Database Backup	CONF.BA CKUP	Displays information about Database backup records.  Database should be backed up regularly to prevent loss of data in the event of a system failure. Oracle Recovery Manager (RMAN) allows performing backup and recovery tasks on your databases. Unencrypted backup data should not be transported on tape or disk to offsite storage for safekeeping.
Instance Name Check	CONF.IN STANCE NAME	Displays whether the instance name contains the Database version number.  Instance names should not contain Oracle version numbers. Service names may be discovered by unauthenticated users. If the service name includes version numbers or other database product information, a malicious user may use that information to develop a targeted attack.
SQL Firewall		Checks if SQL Firewall is enabled and displays the users that are affected by the policy and whether the policy is in observing, blocking, or enforcing mode. Also, details if the SQL and context allow-lists are in enforcement mode or not. Only applicable to Oracle Database versions >=23ai.
Read-only ORACLE_HOME	CONF.RE ADONLY HOME	Checks if the ORACLE_HOME is read-only. Only applicable to Oracle Database versions >=18c.
Access to Dictionary Objects	CONF.SY SOBJ	Displays whether access to dictionary objects is properly limited.  When O7_DICTIONARY_ACCESSIBILITY is set to FALSE, tables owned by SYS are not affected by the ANY TABLE system privileges. This parameter should always be set to FALSE because tables owned by SYS control the overall state of the database and should not be subject to manipulation by users with ANY TABLE privileges.
Inference of Table Data	CONF.SQ L92SECU RITY	1 7



Name	Finding ID	Description	
Access to Password File	CONF.PA SSWORD FILE	Displays whether the password file is configured correctly. The REMOTE_LOGIN_PASSWORDFILE set to EXCLUSIVE allows the password file to contain distinct entries for each administrative user allowing them to be individually audited and tracked for their actions. It also allows passwords to be updated using the ALTER_USER command.	
Network Communication	CONF.NE TWORK	Displays information about initialization parameters that determine the database server response to malformed packets. Also, includes details on usage of a remote listener and if database server version information is hidden from unauthenticated client requests.  REMOTE_LISTENER allows a network listener running on another system to be used. This parameter should normally be unset to ensure that the local listener is used. The SEC_PROTOCOL_ERROR parameters control the database server's response when it receives malformed network packets from a client. Because these malformed packets may indicate an attempted attack by a malicious client, the parameters should be set to log the incident and terminate the connection.  SEC_RETURN_SERVER_RELEASE_BANNER should be set to FALSE to limit the information that is returned to an unauthenticated client, which could be used to help	
External OS Authentication	CONF.EX TERNAL OSAUTH	determine the server's vulnerability to a remote attack. Displays whether the Oracle Database roles are defined and managed by the database itself or by the host operating system (for local and remote authentication). The OS_ROLES parameter determines whether roles granted to users are controlled by GRANT statements in the database or by the database server's operating system. REMOTE_OS_AUTHENT and REMOTE_OS_ROLES allow the client operating system to set the database user and roles. All of these parameters should be set to FALSE so that the authorizations of database users are managed by the database itself.	
Unused Components		Checks to see if components like XOQ, CONTEXT, SDO, DV, OLS are installed/enabled and not being used.	
Job Details	CONF.JO BS	Checks the scheduled database jobs and users who can administer them. Checks include:  Users who can create database jobs  Jobs that can use privileges of DBA/PDB_DBA	
Triggers	CONF.TRI GGERS	Displays information about logon triggers.  A trigger is code that executes whenever a specific event occurs, such as inserting data in a table or connecting to the database. Disabled triggers are a potential cause for concern because whatever protection or monitoring they may be expected to provide is not active.	



Name	Finding ID	Description
Disabled Constraints	CONF.CO NSTRAIN TS	Displays information about disabled constraints.
		Constraints are used to enforce and guarantee specific relationships between data items stored in the database. Disabled constraints are a potential cause for concern because the conditions they ensure are not enforced.
External Procedures	CONF.EX TERNAL	Displays information about external procedures and services.
	PROCS	External procedures allow code written in other languages to be executed from PL/SQL. Note that modifications to external code cannot be controlled by the database. Be careful to ensure that only trusted code libraries are available to be executed. Although the database can spawn its own process to execute the external procedure, it is advisable to configure a listener service for this purpose so that the external code can run as a less-privileged OS user. The listener configuration should set EXTPROC_DLLS to identify the specific shared library code that can be executed rather than using the default value ANY.
Source Code Analysis	CONF.SO URCEAN ALYSIS	Checks DBA_SOURCE for non-oracle maintained procedures and functions using RAISE_APPLICATION_ERROR and DBMS_OUTPUT.PUT_LINE.
Directory Objects	CONF.DI	Displays information about directory objects.
	RECTOR YOBJ	Directory objects allow access to the server's file system from PL/SQL code within the database. Access to files that are used by the database kernel itself should not be permitted, as this may alter the operation of the database and bypass its access controls.
Database Links	CONF.DA	Displays information about database links.
	TABASEL INKS	Database links allow users to execute SQL statements that access tables in other databases. This allows for both querying and storing data on the remote database. It is advisable to set <code>GLOBAL_NAMES</code> to <code>TRUE</code> in order to ensure that link names match the databases they access.
Network Access Control	CONF.NE TWORKA	1 7
	CL	Network ACLs control the external servers that database users can access using network packages such as UTL_TCP and UTL_HTTP. Specifically, a database user needs the connect privilege to an external network host computer if he or she is connecting using the UTL_TCP, UTL_HTTP, UTL_SMTP, and UTL_MAIL utility packages. To convert between a host name and its IP address using the UTL_INADDR package, the Resolve privilege is required. Make sure that these permissions are limited to the minimum required by each user.



Name	Finding ID	Description
XML Database Access Control	CONF.XM LACL	Displays information about XML Database Access Control Lists (ACLs).
		XML ACLs control access to database resources using the XML DB feature. Every resource in the Oracle XML DB Repository hierarchy has an associated ACL. The ACL mechanism specifies a privilege-based access control for resources to principals, which are database users or roles. Whenever a resource is accessed, a security check is performed, and the ACL determines if the requesting user has sufficient privileges to access the resource. Make sure that these privileges are limited to the minimum required by each user.
File System Access	CONF.FIL ESYS	Checks for UTL_FILE_DIR for older database versions where the parameter is not deprecated.
Trace Files	CONF.TR ACEFILE	Displays information about the initialization parameters for trace files.
	LIMIT	The hidden parameter _TRACE_FILES_PUBLIC determines whether trace files generated by the database should be accessible to all OS users. Since these files may contain sensitive information, access should be limited by setting this parameter to FALSE.

The following figure displays an example of the Oracle Database Security Assessment Report — Database Configuration section.



# **Database Configuration**

# Initialization Parameters for Security

Name	Value
ADG_ACCOUNT_INFO_TRACKING	LOCAL
AUDIT_FILE_DEST	/u01/app/oracle/admin/cdb1/adump
AUDIT_SYS_OPERATIONS	TRUE
AUDIT_TRAIL	DB
COMPATIBLE	19.0.0
CURSOR_BIND_CAPTURE_DESTINATION	memory+disk
DBFIPS_140	FALSE
DISPATCHERS	(PROTOCOL=TCP) (SERVICE=cdb1XDB
ENCRYPT_NEW_TABLESPACES	CLOUD_ONLY
GLOBAL_NAMES	FALSE
LDAP_DIRECTORY_ACCESS	NONE
LDAP_DIRECTORY_SYSAUTH	no
O7_DICTIONARY_ACCESSIBILITY	
OS_AUTHENT_PREFIX	ops\$
OS_ROLES	FALSE
OUTBOUND_DBLINK_PROTOCOLS	ALL
PDB_LOCKDOWN	
PDB_OS_CREDENTIAL	
REMOTE_DEPENDENCIES_MODE	TIMESTAMP
REMOTE_LISTENER	
REMOTE_LOGIN_PASSWORDFILE	EXCLUSIVE
REMOTE_OS_AUTHENT	FALSE
REMOTE_OS_ROLES	FALSE
RESOURCE_LIMIT	TRUE
SEC_CASE_SENSITIVE_LOGON	TRUE
SEC_MAX_FAILED_LOGIN_ATTEMPTS	3
SEC_PROTOCOL_ERROR_FURTHER_ACTION	(DROP,3)
SEC_PROTOCOL_ERROR_TRACE_ACTION	NONE
SEC_RETURN_SERVER_RELEASE_BANNER	FALSE
SQL92_SECURITY	TRUE
TABLESPACE_ENCRYPTION	MANUAL_ENABLE

The Database Configuration section is followed by the Network Configuration section.

# Oracle Database Security Assessment Report — Network Configuration

The Oracle Database Security Assessment Report — Network Configuration section displays the following information:

Name	Finding ID	Description	
Network Encryption	NET.ENC RYPTION		
Client Nodes	NET.INVI TEDNOD ES	. ,	
Connection Limits Configuration	NET.CON NECTIO NLIMITS	Check value of parameters governing termination of unauthenticated connections:  SQLNET.INBOUND_CONNECT_TIMEOUT  INBOUND_CONNECT_TIMEOUT_LISTENER  SQLNET.EXPIRE_TIME	
Network Listener Configuration	NET.LIST ENERCO NFIG	Displays information about network listener configuration.	
		<ul> <li>Prevent changes by disabling DYNAMIC_REGISTRATION</li> <li>Limit the nodes that can make changes by enabling         VALID_NODE_CHECKING_REGISTRATION</li> <li>Limit the network sources for changes using the COST         parameters SECURE_PROTOCOL, SECURE_CONTROL, and         SECURE_REGISTER. CONNECTION_RATE determines rate         enforced across all the endpoints that are rate limited</li> </ul>	



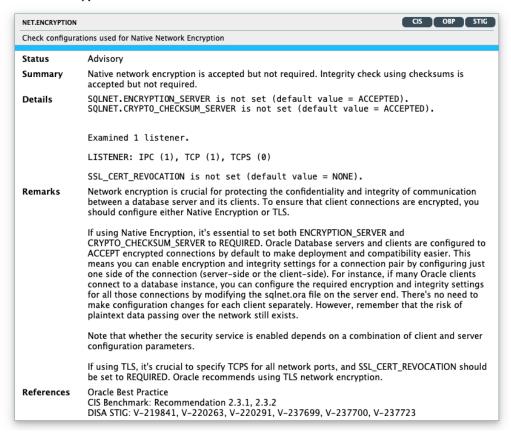
Name	Finding ID	Description
Listener Logging Control	NET.LIST ENERLO	Displays information about network listener logging configuration.
(	G	The LOGGING_LISTENER parameter enables logging of listener activity. Log information can be useful for troubleshooting and to provide early warning of attempted attacks.

The following figure displays an example of the Oracle Database Security Assessment Report — Network Configuration section.

# Figure Oracle Database Security Assessment Report — Network Configuration

## **Network Configuration**

#### **Network Encryption**



The Network Configuration section is followed by the Operating System section.



# Oracle Database Security Assessment Report — Operating System

The Oracle Database Security Assessment Report — Operating System section displays the following information:

Name	Finding ID	Description
Installation Account	OS.INST ALLATIO NUSER	This check specifies the Oracle installation owner.
OS Authentication	OS.AUTH	Displays information about operating system group names and users that can exercise administrative privileges.
		OS authentication allows operating system users within the specified user group to connect to the database with administrative privileges. This shows the OS group names and users that can exercise each administrative privilege. OS users with administrative privileges should be reviewed to prevent any unauthorized, malicious or unintentional access to the database.
Segregation of Production and Development Databases	OS.MULT IDB	Checks for databases/instances running on the same server. If there are multiple databases/instances running on the same server ensure that it is not hosting production and test/development databases.
Process Monitor Processes	OS.PMO N	Displays whether Process Monitor (PMON) processes are running under the <code>ORACLE HOME</code> owner account.
		The PMON process monitors user processes and frees resources when they terminate. This process should run with the user ID of the <code>ORACLE_HOME</code> owner.
Agent Processes	OS.AGE NT	Displays whether Agent processes owners overlap with Listener or Process Monitor (PMON) process owners.
		Agent processes should run with a user ID separate from the database and listener processes. These processes should run under a user ID separate from the database and listener processes.
Listener Processes	OS.LIST ENER	Displays whether Listener process owners overlap with Agent or Process Monitor (PMON) process owners.
		Listener processes accept incoming network connections and connect them to the appropriate database server process. These processes should run with a user ID separate from the database and agent processes. These processes should be administered only through local OS authentication.
CMAN Remote Admin	OS.CMA NLOCAL	Checks if Oracle Connection Manager is installed in the server and if yes, if CMAN remote administration is configured.



Name	Finding ID	Description	
Diagnostic Destination	OS.DIAG NOSTIC DEST	<ul> <li>Checks file permissions if DIAGNOSTIC_DEST is set and is either ORACLE_HOME/rdbms/log or ORACLE_BASE &lt;= 750</li> <li>Checks file permissions if DIAGNOSTIC_DEST is set and is either ORACLE_HOME/rdbms/log or ORACLE_BASE &gt; 750</li> <li>Checks if the value of DIAGNOSTIC_DEST is not equal to ORACLE_HOME/rdbms/log nor</li> </ul>	
File Permissions in ORACLE_HOME	OS.FILE PERMIS SIONS	Displays information about file permissions errors in the ORACLE_HOME.  The ORACLE_HOME directory and its subdirectories contai files that are critical to the correct operation of the database, including executable programs, libraries, data files, and configuration files. Operating system file permissions must not allow these files to be modified by users other than the ORACLE_HOME owner and must not allow other users to directly read the contents of Oracle data files.	

## Note:

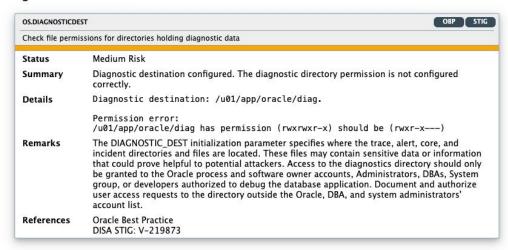
On Windows, the DBSAT Collector collects data only from SQL queries. Since the data from the operating system commands is missing, the DBSAT Reporter runs a subset of rules on this data. Operating System findings are not available for databases running on Windows platform.

The following figure displays an example of the Oracle Database Security Assessment Report — Operating System section.

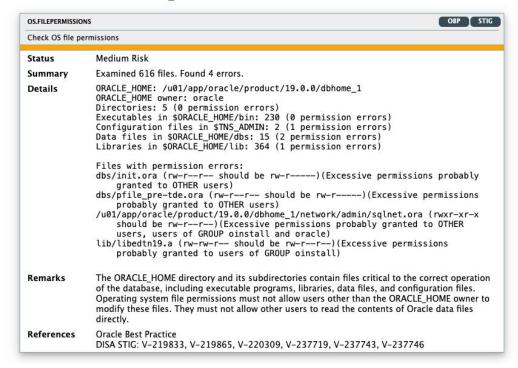


Figure Oracle Database Security Assessment Report — Operating System

#### **Diagnostic Destination**



#### File Permissions in ORACLE\_HOME



The Operating System section is followed by the Diagnostics section.

# Oracle Database Security Assessment Report — Diagnostics

The Diagnostics section displays the checks which could not be executed.



## Note:

This report provides information and recommendations that may be helpful in securing your Oracle database system. These recommendations reflect best practices for database security and should be part of any strategy for Data Protection by Design and by Default. These practices may help in addressing Articles 25 and 32 of the EU General Data Protection Regulation as well as other data privacy regulations. Technical controls alone are not sufficient for compliance. Passing all findings does not guarantee compliance.

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# Using the Discoverer

You can generate the Oracle Database Sensitive Data Assessment Report with the Discoverer component.

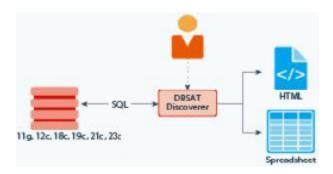
# Oracle Database Sensitive Data Assessment Report

The Discoverer component is used to generate the Oracle Database Sensitive Data Assessment Report.

The following figure shows the components and architecture of the Discoverer.



Figure Discoverer Components and Architecture



# Using the Discoverer

The Discoverer executes SQL queries and collects data from the system to be assessed, based on the settings specified in the configuration and pattern files.

# Configuring the Discoverer

# Configuring dbsat.config

The settings in the configuration file determine the behavior of the Discoverer.

To configure the Discoverer, do the following:

- 1. Access the directory where Oracle DBSAT is installed.
- 2. Navigate to the Discover/conf directory. Make a copy of the sample\_dbsat.config file and rename the file to match your site—specific requirements. For example, you can rename the file to custom dbsat.config.



Creating a duplicate file ensures that your custom settings are not overwritten during reinstallation.

Open custom\_dbsat.config.

The following are the contents of the configuration file:

```
[Database]
    TNS_ADMIN =
    NET_SERVICE_NAME =
    WALLET_LOCATION =

DB_HOSTNAME = localhost
    DB_PORT = 1521
    DB_SERVICE_NAME =
```



```
SSL ENABLED = FALSE
       SSL TRUSTSTORE =
       SSL TRUSTSTORE TYPE =
       SSL KEYSTORE =
       SSL KEYSTORE TYPE =
       SSL DN =
       SSL VERSION =
       SSL CIPHER SUITES =
[Discovery Parameters]
       sensitive pattern files = sensitive en.ini
       schema scope = ALL
       minrows = 1
       exclusion list file =
[Sensitive Categories]
       Identification Info - National IDs = High Risk
       Identification Info - Personal IDs = High Risk
       Identification Info - Public IDs = High Risk
       Biographic Info - Address = High Risk
       Biographic Info - Family Data = High Risk
       Biographic Info - Extended PII = High Risk
       Biographic Info - Restricted Data = High Risk
       IT Info - User Data = High Risk
       IT Info - Device Data = Medium Risk
       Financial Info - Card Data = High Risk
       Financial Info - Bank Data = High Risk
       Health Info - Insurance Data = High Risk
       Health Info - Provider Data = Medium Risk
       Health Info - Medical Data = Medium Risk
       Job Info - Employee Data = High Risk
       Job Info - Org Data = Low Risk
       Job Info - Compensation Data = High Risk
       Academic Info - Student Data = High Risk
       Academic Info - Institution Data = Medium Risk
       Academic Info - Performance Data = Low Risk
```

#### Note:

Keep the [Database], [Discovery Parameters], and [Sensitive Categories] entries for the sections. If you remove these lines, DBSAT discoverer will fail to execute.

- 4. Configure the settings. For more information about the configuration settings, see Configuration Settings.
- 5. Save and close the configuration file.



# **Configuration Settings**

Section	Key	Value	Description
[Database]	TNS_ADMIN	<pre><network location="" name="" service=""></network></pre>	Location from where network service names needs to be read
-	NET_SERVICE_NAME	<pre><net_service_name></net_service_name></pre>	Network Service name to be used to make connection
-	WALLET_LOCATION	<pre><ssl location="" wallet="">   <seps location="" wallet=""></seps></ssl></pre>	Location of wallets for secured connections via SSL or SEPS (Secure External Password Store)
-	DB_HOSTNAME	<hostname>   <ip_address></ip_address></hostname>	Hostname or IP Address of the target database server
-	DB_PORT	<pre><portnumber> The default is 1521.</portnumber></pre>	Listener port number for the target database. If a port number is not specified, the default port 1521 is used.
-	DB_SERVICE_NAME	<pre><service_name></service_name></pre>	Service name for the target database
	SSL_ENABLED	TRUE   FALSE The default is FALSE.	Specifies if SSL is enabled or disabled when connecting to the Database Server. This is an optional argument.  It is recommended that the SSL_ENABLED value is set to TRUE.  Retain the default FALSE value if you do not require an SSL connection to the Database Server.  If SSL_ENABLED = TRUE, then SSL_TRUSTSTORE is mandatory.
-	SSL_TRUSTSTORE	<a href="Absolute path"><a href="Absolute path">Absolute path</a><a href="Absolute path"><a href="Absolute path"></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a></a>	



Section	Key	Value	Description
-	SSL_TRUSTSTORE_TY PE	PKCS12   JKS   SSO	Specifies the type of TrustStore.
			Use PKCS12 if the Truststore is a Wallet.
			Use JKS if the Truststore is a Java KeyStore.
			Use SSO if the Truststore is an auto- login SSO Wallet.
-	SSL_KEYSTORE	<absolute path="" to<br="">the KeyStore/ KeyStore filename&gt;</absolute>	Specifies the absolute path to the KeyStore, and the KeyStore file name.
		<pre>Example: /opt/ oracle/wallets/ keystore.jks</pre>	If SSL_KEYSTORE is not specified, the value specified in SSL_TRUSTSTORE is used.
			Mandatory if the Database server requires client authentication.
-	SSL_KEYSTORE_TYPE	PKCS12   JKS   SSO	Specifies the type of KeyStore.
			Use PKCS12 if the KeyStore is a Wallet. Use JKS if the KeyStore is a Java KeyStore.
			Use SSO if the KeyStore is an auto- login SSO Wallet.
-	SSL_DN	<distinguished_na me=""></distinguished_na>	Distinguished Name (DN) of the target Database server.
			Specify the DN if the server's DN needs to be checked.
			This is an optional argument.



Section	Key	Value	Description
-	SSL_VERSION	1.0   1.1   1.2  The default is 1.2.	Specifies the version of the SSL protocol to use when connecting to the Database Server. This is an optional argument.  Use 1.0 for SSL version TLSv1.0.  Use 1.1 for SSL version TLSv1.1.  Use 1.2 for SSL version TLSv1.2.
	SSL_CIPHER_SUITES	<pre><cipher_suite1>, &lt; cipher_suite2&gt; Example: TLS_RSA_WITH_AES_ 256_CBC_SHA256 , SSL_RSA_WITH_RC4_ 128_MD5</cipher_suite1></pre>	Specifies the Cryptographic Algorithms to be used. Multiple entries can be specified as a comma- separated list. This is an optional argument. For information about supported cryptographic suites, see https:// docs.oracle.com/ javase/8/docs/ technotes/guides/ security/ SunProviders.html.
[Discovery Parameters]	SENSITIVE_PATTERN _FILES	<file_name>   <file_name1>, <file_name2> The default is sensitive_en.ini.</file_name2></file_name1></file_name>	Specifies the pattern files to be used. Multiple files can be specified as a commaseparated list. The limit is 10 files. For more information about configuring the Sensitive Data Type pattern file, see Pattern File Configuration (Optional).
-	SCHEMA_SCOPE	ALL   <schema1>,<schema 2=""> The default is ALL.</schema></schema1>	Specifies the schemas to be scanned. Multiple schemas can be specified as a comma-separated list.



Section	Key	Value	Description
-	MINROWS	<pre><numerical value=""> The default is 1.</numerical></pre>	Specifies the minimum number of rows in a table for that table to be scanned.  Tables with a number of rows less than what is specified in the minrows parameter are excluded from the scan.
-	EXCLUSION_LIST_FI LE	<pre><exclusion_list_f ilename="">.ini</exclusion_list_f></pre>	Specifies the file to be used to exclude schemas, tables, or columns from the scan.  For more information about configuring the Exclusion List file, see Configuring the Exclusion List File (Optional).
[Sensitive Categories]			The [Sensitive Categories] section defines which Sensitive Categories are used. Valid risk levels are:  Low Risk  Medium Risk  High Risk  The types of sensitive data are defined in the Sensitive Data Type pattern file. For more information about configuring the Sensitive Data Type pattern file, see Pattern File Configuration (Optional).

# Pattern File Configuration (Optional)

The Oracle Database Security Assessment Tool searches for the types of sensitive data defined in the Pattern file(s).

About Sensitive Types



Pattern files contain the patterns to search for. A Pattern file is grouped into sections, defined by the section heading format  $[SENSITIVE\_TYPE\_NAME]$ . Each section constitutes a Sensitive Type.

The following example shows a sample Sensitive Type section for Full NAME.

```
[FULL NAME]

COL_NAME_PATTERN = ^(?!.*(ITEM|TAX|BALANCE)).*(FULL.*NAME)|(^|[_-])

(CUSTOMER|CUST|CLIENT|PATIENT|PERSON).?(NAME|NM)($|[_-])

COL_COMMENT_PATTERN = ^(?!.*(ITEM|TAX|BALANCE)).*(FULL.?NAME)|

(CUSTOMER|CUST|CLIENT|PATIENT|PERSON).?NAME

SENSITIVE CATEGORY = Identification Info - Public IDs
```

The Sensitive Type name [SENSITIVE\_TYPE\_NAME] is displayed in the Sensitive Type column of the Database Sensitive Data Assessment Report — Sensitive Column Details section. For more information about the Database Sensitive Data Assessment Report, see Oracle Database Sensitive Data Assessment Report.

Each Sensitive Type is defined by the following three parameters: COL\_NAME\_PATTERN, COL COMMENT PATTERN, and SENSITIVE CATEGORY.

## COL NAME PATTERN

The COL\_NAME\_PATTERN parameter specifies the text to search for in the Regular Expression (RegExp) patterns of the database column names.

```
(^LNAME$) | ((LAST|FAMILY|SUR|PATERNAL).*NAME$)
```

In the example above, the following text will be searched for in the RegExp patterns of the database column names:

- (^LNAME\$) Searches for a column titled LNAME.
- ((LAST|FAMILY|SUR|PATERNAL).\*NAME\$) Searches for column names that contain LAST, FAMILY, SUR, or PATERNAL, followed by any characters and ending with NAME. For example, LAST NAME or CUSTOMER SURNAME.

## COL COMMENT PATTERN

The COL\_COMMENT\_PATTERN parameter specifies the text to search for in the Regular Expression (RegExp) patterns of the database column comments.

## SENSITIVE CATEGORY

The SENSITIVE\_CATEGORY parameter specifies the type of sensitive data. The risk levels associated with exposing types of sensitive data are specified in the sample dbsat.config file. The risk levels are:

- Low Risk
- Medium Risk



High Risk

For more information about configuring the <code>sample\_dbsat.config</code> file, see Configuration Settings.

Customizing the Pattern File

To customize the Pattern file, do the following:

- Access the directory where Oracle DBSAT is installed.
- Navigate to the Discover/conf directory. Make a copy of the sensitive\_en.ini file and rename the file my\_sensitive\_en.ini.

### Note:

The Discover/conf directory also contains the following languagespecific .ini files to help discover sensitive data in data dictionaries in major European languages (filename - country, language):

- sensitive de.ini German, Germany.
- sensitive el.ini Greek, Greece.
- sensitive es.ini Spanish, Spain.
- sensitive fr.ini French, France.
- sensitive\_it.ini Italian, Italy.
- sensitive nl.ini Dutch, Netherlands.
- sensitive\_pt.ini Portuguese, Portugal.
- 3. Open my\_sensitive\_en.ini.
- Customize the settings by adding new Sensitive Types and modifying existing Sensitive Types.

For more information about adding new Sensitive Types and Sensitive Categories to the Pattern file, see About Sensitive Types and Configuration Settings.

5. Save and close my\_sensitive\_en.ini.

The Pattern file is configured.

6. Include my\_sensitive\_en.ini in the Discoverer scan by adding a reference to the file in the custom dbsat.config file.

```
sensitive_pattern_files = my_sensitive_en.ini
```

For more information about referencing the Pattern file in the <code>custom\_dbsat.config</code> file, see Configuring dbsat.config.

**About Regular Expressions** 



The search parameters use regular expressions, sets of strings based on common characteristics shared by each string in the set. Regular expressions vary in complexity, but once you understand the basics of how they are constructed, you can decipher or create any regular expression. You can use character classes, capturing groups, quantifiers, boundary matchers, and logical operators to define regular expressions.

## String Literals

The most basic form of pattern matching is the match of a string literal. For example, if the regular expression is EMP and the input string is EMP, the match succeeds because the strings are identical. This regular expression also matches any string containing EMP, such as EMPLOYEE, TEMP, and TEMPERATURE.

#### Metacharacters

You can also use some special characters that affect the way a pattern is matched. One of the most common ones is the dot (.) symbol, which matches any character. For example, <code>EMPLOYEE.ID</code> matches <code>EMPLOYEE\_ID</code> and <code>EMPLOYEE-ID</code>, but not <code>EMPLOYEE\_VERIFICATION\_ID</code>. Here, the dot is a metacharacter — a character with special meaning interpreted by the matcher.

Some other metacharacters are:  $^{\ }$  ? + \*  $^{\ }$  - [ ] ( ) { }.

If you want a metacharacter to be treated literally (as an ordinary character), you can use a backslash ( $\setminus$ ) to escape it. For example, the regular expression 9 + 9 matches 9+9.

#### **Character Classes**

A character class is a set of characters enclosed within square brackets. It specifies the characters that successfully match a single character from a given input string.

The following table describes some common regular expression constructs.

Construct	Description
[abc]	Matches one of the characters mentioned within square brackets.
	Example: EMPLOYE [ER] matches EMPLOYEE and EMPLOYER.
[^abc]	Matches any character except the ones mentioned within square brackets.
	Example: [^BC] AT matches RAT and HAT, but does not match BAT and CAT.
[A-Z0-9]	Matches any character in the range mentioned within square brackets. To specify a range, simply insert the dash metacharacter "-" between the first and last character to be matched; for example, [1-5] or [A-M]. You can also place different ranges beside each other within the class to further expand the match possibilities.  Example: [B-F]AT matches BAT, CAT, DAT, EAT, and FAT, but does not match AAT and GAT.



# See Also:

- Character Classes
- Predefined Character Classes

# **Capturing Groups**

You can use capturing groups to treat multiple characters as a single unit. A capturing group is created by placing the characters to be grouped inside a set of parentheses. For example, the regular expression (SSN) creates a single group containing the letters S, S, and N.



**Capturing Groups** 

# Quantifiers

You can use quantifiers to specify the number of occurrences to match against.

The following table describes some common quantifiers.

Quantifier	Description	
X?	Matches zero or one occurrence of the specified character or group of characters.	
	Example: SSN_NUMBERS? matches strings SSN_NUMBER and SSN_NUMBERS.	
Х*	Matches zero or more occurrences of the specified character or group of characters.	
	Example: TERM.*DATE matches strings like TERMDATE, TERM_DATE and LAST_TERMINATION_DATE.	
X+	Matches one or more occurrences of the specified character or group of characters.	
	Example: TERM. + DATE matches strings like TERM_DATE and TERMINATION_DATE, but not TERMDATE.	
X{n}	Matches the specified character or group of characters exactly n times.	
	Example: 9{3} matches 999, but not 99.	
X{n,}	Matches the specified character or group of characters at least n times.	
	Example: 9{3,} matches 999, 9999, and 99999, but not 99.	
X{n,m}	Matches the specified character or group of characters at least $n$ times but not more than m times.	
	Example: 9{3,4} matches 999 and 9999, but not 99.	



An example of regular expression using character class is SSN[0-9]+, which matches strings like SSN0, SSN1, and SSN12. Here, [0-9] is a character class and is allowed one or more times. The regular expression however, does not match SSN.



## **Boundary Matchers**

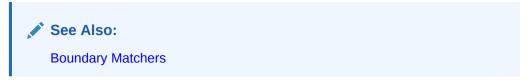
You can use boundary matchers to make pattern matching more precise by specifying where in the string the match should take place. For example, you might be interested in finding a particular word, but only if it appears at the beginning or end of an input string.

The following table describes common boundary matchers.

Boundary Construct	Description
^	Matches the specified character or group of characters at the beginning of a string (starts with search).
	Example: ^VISA matches strings beginning with VISA.
\$	Matches the specified character or group of characters at the end of a string (ends with search).
	Example: NUMBER\$ matches strings ending with NUMBER.
\b	Marks a word boundary. Matches the character or group of characters specified between a pair of \b only if it is a separate word (as opposed to substring within a longer string).
	Example: \bAGE\b matches strings like EMPLOYEE AGE and PATIENT AGE INFORMATION, but does not match strings like AGEING and EMPLOYEEAGE.

If no boundary matcher is specified, a contains search is performed. For example, ELECTORAL matches strings containing ELECTORAL, such as ELECTORAL\_ID, ID ELECTORAL, and ELECTORALID.

An exact match search can be performed by using ^ and \$ together. For example, ^ADDRESS\$ searches for the exact string ADDRESS. It matches the string ADDRESS, but does not match strings like PRIMARY ADDRESS and ADDRESS HOME.



**Logical Operators** 



You can use the pipe or vertical bar character (|) if you want to match any one of the characters (or group of characters) separated by pipe. For example, EMPLOY (EE | ER) ID matches EMPLOYEE ID and EMPLOYER ID.

#### **Examples**

^JOB.\* (TITLE|PROFILE|POSITION) \$ matches strings beginning with JOB, followed by zero or more occurrences of any character, and ending with TITLE, PROFILE, or POSITION.

 $^{A-Z}_{3}_{0-9}_{1}_{2}_{A-Z0-9}$  matches strings beginning with three letters, followed by two digits, and ending with a letter or digit.

BIRTH.?(COUNTRY|PLACE) | (COUNTRY|PLACE).\*BIRTH matches strings such as BIRTH COUNTRY, PATIENT\_BIRTH\_PLACE, PLACE\_OF\_BIRTH, and EMPLOYEE'S COUNTRY OF BIRTH.



**Regular Expressions** 

# Configuring the Exclusion List File (Optional)

You can specify schemas, tables, or columns to exclude from the scan in the Exclusion List file.

This is an optional step but often required to fine tune the Discoverer to exclude false positives.

To create an Exclusion List file, do the following:

- Create an Exclusion List file, and save it in the Discover/conf directory as myexclusion list.
- 2. Specify the schemas, tables, or columns to exclude from the Discoverer scan.

The following is a sample of the contents of the Exclusion List file.

PAYROLL
IT.ENTITLEMENTS
HR.EMPLOYEE.MARITAL\_STATUS
HR.JOB.CANDIDATE

Specify the schemas, tables, or columns to exclude using the format SchemaName. TableName. ColumnName. Type each exclusion entry on a new line.

In the example above, PAYROLL excludes the PAYROLL schema from the discovery scan; IT.ENTITLEMENTS excludes the ENTITLEMENTS table in IT schema; HR.EMPLOYEE.MARITAL\_STATUS excludes column MARITAL\_STATUS from the HR.EMPLOYEE table. Similarly, HR.JOB.CANDIDATE excludes column CANDIDATE from HR.JOB table.





## Tip:

The Discoverer CSV report includes a column with the fully qualified column names (FULLY QUALIFIED COLUMN NAME). This column can be used to create the exclusion list file contents and speed up the removal of unwanted columns or false positives from the report in a subsequent run.

- Save and close the Exclusion List file.
- Update the exclusion list file entry in your custom dbsat.config file to exclusion list file = myexclusion list

For more information about referencing the Exclusion List file, see Configuring dbsat.config.

# Configuring Certificates and Wallets (Optional)

The Discoverer allows usage of Secure External Password Store to retrieve login credentials stored a wallet while connecting. Secure External Password Store can be used to connect to Database without entering the username and password. Secure External Password Store improves the security and allows automation of the execution of the Discoverer.

For increased security, Oracle Database provides Secure Sockets Layer (SSL) support to encrypt the connection between clients and the server. If SSL (TLS) encryption is configured on the Database Server, the Discoverer needs to be configured in order to connect and discover data. Configuration parameters for SSL can be found in the dbsat.config file.

To establish an SSL connection with the Discoverer, the Database Server sends its certificate, which is stored in its wallet. The client may or may not need a certificate or wallet, depending on the server configuration.



#### Note:

Configuring certificates and wallets is an optional step and needs to be performed only when using SSL to connect to the Oracle Database server.

For more information about configuring certificates and wallets, see Support for SSL in the Oracle Database JDBC Developer's Guide.

# Running the Discoverer

To run the Discoverer, do the following:



1. Specify the arguments to run the Discoverer:

```
$ dbsat discover [-n] -c <config file> <output file>
```

The dbsat discover command has the following options and arguments:

-r

Specifies that there is no encryption for output.

-c

Specifies the name of the configuration file used for discoverer. For more information about the *config file* file, see Configuring dbsat.config.

• output file

Specifies the full or relative path name to create the .zip file. Do not add an extension.

Example: /home/oracle/dbsat/PDB1

2. Run the Discoverer.

```
$ ./dbsat discover -c Discover/conf/custom dbsat.config PDB1
```

The following output is displayed:

```
DBSAT Discover ran successfully.

Calling /usr/bin/zip to encrypt the generated reports...

Enter password:

Verify password:

adding: PDB1_discover.html (deflated 86%)

adding: PDB1_discover.csv (deflated 86%)

Zip completed successfully.
```

3. Specify a password to encrypt the .zip file.

A zip file named <destination>\_report.zip is created. If the file <destination>\_report.zip exists, the discovery results are added to the existing zip file.



The .zip file is used for Reporter and Discoverer output. To avoid confusion, it is recommended that you use the same password while creating both outputs.

4. Extract the contents of the .zip file to access the Database Sensitive Data Assessment Report. When prompted, enter the password to decrypt the .zip file specified in Step 3.



The contents of the .zip file are extracted.

**5.** Use the appropriate tools to read the Database Sensitive Data Assessment Report.

Example: Use a browser to display the .html file.

Example: Use a spreadsheet reader like OpenOffice Calc or Excel to open the .csv file.

# Oracle Database Sensitive Data Assessment Report

The Discoverer component is used to generate the Oracle Database Sensitive Data Assessment Report in HTML and CSV formats.

The HTML report is the main report and contains the discovered sensitive data and its categories along with target database information and Discoverer parameters.

The CSV report can be loaded into Oracle Audit Vault and Database Firewall to add sensitive data context to the new Data Privacy reports. For more information about this functionality, see Importing Sensitive Data Into AVDF Repository in the Oracle Audit Vault and Database Firewall Auditor's Guide.

# Oracle Database Sensitive Data Assessment Report — High-Level Summary

The Oracle Database Sensitive Data Assessment Report — High-Level Summary section contains the following information:

Table Oracle Database Sensitive Data Assessment Report — High-Level Summary

escription
isplays when the Sensitive Data Assessment report was generated. The BSAT Discoverer version is also displayed.
isplays the details of the database assessed by the Discoverer.
isplays the version of the database assessed by the Discoverer.
isplays the Discovery Parameters specified in the configuration file. For more formation about Discovery Parameters, see Configuration Settings.
is is

The following figure displays the first four tables of the Oracle Database Sensitive Data Assessment Report — High-Level Summary section.



# Figure Oracle Database Sensitive Data Assessment Report — High-Level Summary

#### Assessment Date & Time

Date of DBSAT Report Generation	<b>DBSAT Discoverer Version</b>	
Wed Jan 10 2024 16:39:34	3.1 (Jan 2024)	

#### **Database Identity**

Name	Container (Type:ID)	Platform	Database Role	Log Mode	Date Created
CDB1	PDB1 (PDB:3)	Linux x86 64-bit	PRIMARY	NOARCHIVELOG	Wed Oct 30 2019 15:41:51

#### **Database Version**

Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production

#### **Discovery Parameters**

Parameter	Values
Schema Scope	ALL
Exclusion List File	NONE
Minimum Rows Count	1
Pattern File(s)	sensitive_en.ini

The High-Level Summary section is followed by the Summary section.

# Oracle Database Sensitive Data Assessment Report — Summary

The Oracle Database Sensitive Data Assessment Report — Summary section displays information about the number of tables, columns, and rows identified as sensitive data, grouped by Sensitive Category.

The Database Sensitive Data Assessment Report — Summary section contains the following columns:

Table Oracle Database Sensitive Data Assessment Report — Summary

Column Name	Description
Sensitive Category	Displays the name of the Sensitive Category
# Sensitive Tables	Displays the number of tables detected that contain sensitive data
# Sensitive Columns	Displays the number of columns detected in the tables that contain sensitive data
# Sensitive Rows	Displays the number of rows detected in the tables that contain sensitive data



The following figure displays the information displayed in the Oracle Database Sensitive Data Assessment Report — Summary section:

Figure Oracle Database Sensitive Data Assessment Report — Summary

# Summary

Sensitive Category	# Sensitive Tables	# Sensitive Columns	# Sensitive Rows
BIOGRAPHIC INFO - ADDRESS	10	39	6307309
BIOGRAPHIC INFO - EXTENDED PII	2	2	2000
FINANCIAL INFO - BANK DATA	2	2	599
FINANCIAL INFO - CARD DATA	7	7	3004
HEALTH INFO - PROVIDER DATA	1	1	149
<b>IDENTIFICATION INFO - NATIONAL IDS</b>	2	6	2000
IDENTIFICATION INFO - PERSONAL IDS	4	4	505
IDENTIFICATION INFO - PUBLIC IDS	9	26	2401125
IT INFO - USER DATA	13	15	12997
JOB INFO - COMPENSATION DATA	10	12	3149
JOB INFO - EMPLOYEE DATA	8	16	406
JOB INFO - ORG DATA	5	6	278
TOTAL	30*	136	8617513**

## Note:

A single database table could contain columns or column comments that match more than one Sensitive Category, causing a higher number to be displayed in the # Sensitive Tables and # Sensitive Rows columns. However, the Total row displays the unique number of tables and rows identified as sensitive data.

For more information about configuring Sensitive Categories, see Pattern File Configuration (Optional).

The Summary section is followed by the Sensitive Data section.

# Oracle Database Sensitive Data Assessment Report — Sensitive Data

The Oracle Database Sensitive Data Assessment Report — Sensitive Data section displays information about the schemas containing sensitive data.

The Oracle Database Sensitive Data Assessment Report — Sensitive Data section contains the following information:



Table Oracle Database Sensitive Data Assessment Report — Sensitive Data

Section	Description
Risk Level(s)	Displays the Risk Level(s) of the sensitive data identified in the schema of the database assessed by the Discoverer.
Summary	Displays a summary of the occurrence of sensitive data in the schema.
Location	Displays the names of the schemas containing sensitive data.

The following figure shows the information displayed in the Oracle Database Sensitive Data Assessment Report — Sensitive Data section.

#### Figure Oracle Database Sensitive Data Assessment Report — Sensitive Data

#### **Sensitive Data**

#### Schemas with Sensitive Data



Findings belonging to each risk level are followed by a set of recommendations to secure the sensitive data. These recommendations lists various controls based on the Risk Levels, namely HIGH, MEDIUM, and LOW.

The following figure shows the information displayed in the Risk Level: High Risk section.

#### Figure Sensitive categories grouped by Risk Level

## Risk Level: High Risk

# Security for Environments with High Value Data: Detective plus Strong Preventive Controls Highly sensitive and regulated data should be protected from privileged users, and from users without a business need for the data. Activity of privileged accounts should be controlled to protect against insider threats, stolen credentials, and human error. Who can access the database and what can be executed should be controlled by establishing a trusted path and applying command rules. Sensitive data should be redacted on application read only screens. A Database Firewall ensures that only approved SQL statements or access by trusted users reaches the database – blocking unknown SQL injection attacks and the use of stolen login credentials. Recommended controls include: • Audit all sensitive operations including privileged user activities

- Audit access to application data that bypasses the application
- Encrypt data to prevent out-of-band access
- Mask sensitive data for test and development environments
- Restrict database administrators from accessing highly sensitive data
- Block the use of application login credentials from outside of the application
- Monitor database activity for anomalies
- Detect and prevent SQL Injection attacks
- Evaluate: Oracle Audit Vault and Database Firewall, Oracle Advanced Security, Oracle Data Masking and Subsetting, Oracle Database Vault



Each Risk Level section is followed by a list of the tables detected that contain sensitive data. The following information is displayed:

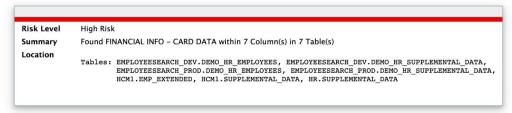
Table Tables Detected within Sensitive Category: <Sensitive Category Name>

Name	Description
Risk Level	Displays the Risk Level
Summary	Displays a summary of the sensitive category data detected
Location	Displays the names of the tables that contain sensitive data

The following figure shows the information displayed in the Tables Detected within each Sensitive Category: <Sensitive Category Name> subsection.

Figure Tables Detected within Sensitive Category: <Sensitive Category Name>

Tables Detected within Sensitive Category: FINANCIAL INFO - CARD DATA



The Sensitive Data section is followed by the Schema View section.

# Oracle Database Sensitive Data Assessment Report — Schema View

The Oracle Database Sensitive Data Assessment Report — Schema View section displays information about the schemas, tables, columns, and rows containing sensitive data. The Sensitive Category is also displayed.

The Oracle Database Sensitive Data Assessment Report — Summary section contains the following columns:

Column Name	Description
Schema	Displays the name of the schema
Table Name	Displays the name of the table
Columns	Displays the number of columns in the table
Sensitive Columns	Displays the number of columns detected that contain sensitive data



Column Name	Description
Rows	Displays the number of rows in the table
Sensitive Category	Displays the category of sensitive data detected in each column

The following figure highlights the information displayed in the Oracle Database Sensitive Data Assessment Report — Schema View section:

Figure Oracle Database Sensitive Data Assessment Report — Schema View

ble Summary		le Summary										
Schema	Table Name	Columns	Sensitive Columns	Rows	Sensitive Category							
DMS_ADMIN	MASK_DATA	9	7	10000	BIOGRAPHIC INFO – ADDRESS, IDENTIFICATION INFO – PUBLIC IDS, IT INFO – USER DATA							
EMPLOYEESEARCH_DEV	DEMO_HR_EMPLOYEES	34	16	1000	BIOGRAPHIC INFO – ADDRESS, BIOGRAPHIC INFO – EXTENDED PII, FINANCIAL INFO – CARD DATA, IDENTIFICATION INFO – NATIONAL IDS, IDENTIFICATION INFO – PUBLIC IDS, IT INFO – USER DATA, JOB INFO – COMPENSATION DATA							
EMPLOYEESEARCH_DEV	DEMO_HR_ROLES	2	1	26	IT INFO - USER DATA							
EMPLOYEESEARCH_DEV	DEMO_HR_SUPPLEMENTAL_DATA	6	4	184	FINANCIAL INFO - BANK DATA, FINANCIAL INFO - CARD DATA, IT INFO USER DATA, JOB INFO - COMPENSATION DATA							

The Schema View section is followed by the Sensitive Column Details section.

# Oracle Database Sensitive Data Assessment Report — Sensitive Column Details

The Oracle Database Sensitive Data Assessment Report — Sensitive Column Details section displays information about the columns containing sensitive data. The Sensitive Category and Type are also displayed.

Column Name	Description					
Schema Name	Displays the name of the schema					
Table Name	Displays the name of the table					
Column Name	Displays the name of the column					
Column Comment	Displays the column comment					
Sensitive Category	Displays the category of sensitive data detected in each column					
Sensitive Type	Displays the type of sensitive data detected in each column					
Risk Level	Displays the risk level					

The following figure displays the information displayed in the Oracle Database Sensitive Data Assessment Report — Sensitive Column Details section.



# Figure Oracle Database Sensitive Data Assessment Report — Sensitive Column Details

Schema Name	Table Name	Column Name	Column Comment	Sensitive Category	Sensitive Type	Risk Level
DMS_ADMIN	MASK_DATA	CITY		BIOGRAPHIC INFO - ADDRESS	CITY	High Risk
DMS_ADMIN	MASK_DATA	GIVENNAME		IDENTIFICATION INFO - PUBLIC IDS	FIRST NAME	High Risk
DMS_ADMIN	MASK_DATA	STREETADDRESS		BIOGRAPHIC INFO - ADDRESS	STREET	High Risk
DMS_ADMIN	MASK_DATA	SURNAME		IDENTIFICATION INFO - PUBLIC IDS	LAST NAME	High Risk
DMS_ADMIN	MASK_DATA	TELEPHONENUMBER		IDENTIFICATION INFO - PUBLIC IDS	PHONE NUMBER	High Risk
DMS_ADMIN	MASK_DATA	USERNAME	)	IT INFO - USER DATA	USER ID	High Risk
DMS_ADMIN	MASK_DATA	ZIPCODE		BIOGRAPHIC INFO - ADDRESS	POSTAL CODE	High Risk
EMPLOYEESEARCH_DEV	DEMO_HR_EMPLOYEES	ADDRESS_1		BIOGRAPHIC INFO - ADDRESS	FULL ADDRESS	High Risk

# **Best Practices**

# Collector - OS Commands

As a general best practice, you should not put username/password credentials in cleartext in an application or file. When you provide the password on the command line while executing <code>dbsat collect</code>, someone can retrieve credentials, either using history or executing the <code>ps</code> Unix command or any similar Windows command. Therefore, Oracle recommends that you enter the password when prompted.

# Collector - Database User Account

It's advisable that you run DBSAT collect and discoverer with a user that has the minimum set of privileges required to execute the assessments. The user shall also have a strong password. This will help reduce the attack surface and the potential impact of stolen DBSAT user account credentials, account misuse, and human error.

You can create a user with the required minimum privileges to run the Oracle Database Security Assessment Tool with the script provided in the pre-requisites section.

# Securing DBSAT Output Files

By default, DBSAT produces password-protected zip files. As DBSAT output can contain sensitive information, it is recommended not to override the default. Mishandling of assessment information can introduce risk.

# **Excluding Sensitive User Accounts**



DBSAT allows you to exclude users from the security assessment report. If there are critical users that you do not want to show in the report, you can exclude them by using the -u option in dbsat report execution.

# **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 customers that have purchased support have access to electronic support through My Oracle Support. For information, visit <a href="http://www.oracle.com/pls/topic/lookup?ctx">http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs</a> if you are hearing impaired.

# Appendix A

# Improved DBSAT Target Specific Checks and Recommendations

Oracle DBSAT can be run against on-premises databases, Autonomous Databases (Serverless and Dedicated) and Oracle Cloud DBCS (DBSystems EE/HP/EP). Some findings will execute different checks and provide specific recommendations for these databases. The table below highlights which findings were improved.



# Figure DBSAT Target Specific Checks and Recommendations

New Rule ID	Old Rule ID	Finding Title	(On-premises)		Oracle Autonomous Database Specific		Oracle Base	
			Check (1)	Remarks (2)	Serverless (3)	Dedicated (4)	Database EE/EP/HP (5)	References
INFO.PATCH	INFO.PATCH	Patch Check	No	No	Yes	Yes	No	OBP, CIS, STIG
USER.DEFAULTPROFILE	-	Users with DEFAULT Profile	New	N/A	No	No	No	CIS
USER.DEFPASSWORD	USER.DEFPWD	Users with Default Passwords	No	No	No	No	No	OBP, CIS, STIG
USER.EXPIRED	USER.EXPIRED	Users with Expired Passwords	No	No	No	No	No	OBP
USER.INACTIVE	USER.INACTIVE	Inactive Users	No	No	No	No	No	OBP, STIG
USER.SAMPLE	USER.SAMPLE	Sample Schemas	No	No	Yes	No	No	OBP, CIS, STIG
USER.APPOWNER	USER.APPOWNER	Application Owner Account	Yes	No	No	No	No	OBP, STIG
USER.SHARED	USER.SHARED	Shared Accounts	No	No	No	No	No	OBP, STIG
USER.OBJOWNER	USER.OBJOWNER	Users with Objects	No	No	No	No	No	STIG
USER.OBJAUTHZ	USER.OBJAUTHZ	Users Authorized for Object Ownership	No	No	No	No	No	STIG
USER.SECURITYOBJS	USER.SECURITYOBJS	Users with Security Objects	No	No	No	No	No	STIG
USER.GRANTOPTION	USER.GRANTOPTION	Users with Grant Option	No	No	No	No	No	OBP, STIG

# Figure DBSAT Target Specific Checks and Recommendations (continued)

USER.SENSITIVEDATA	USER.SENSITIVEDATA	Users with Sensitive Data	No	No	No	No	No	OBP, STIG
USER.TABLESPACE	USER.TBLSPACE	User Schemas in SYSTEM or SYSAUX Tablespace	No	No	No	No	No	OBP, STIG
USER.PASSWORDCASE	USER.CASE	Case-Sensitive Passwords	No	No	Yes	Yes	No	OBP, CIS
USER.AUTHLEGACY	USER.VERIFIER	Legacy Password Versions	No	No	No	No	No	ОВР
USER.PASSWORDFUNCTION	USER.PASSWD	Users with no Password Complexity Requirements	No	No	No	No	No	OBP, CIS, STIG
USER.NOLOCK	USER.NOLOCK	Account Locking after Failed Login Attempts	No	No	No	No	No	OBP, CIS, STIG
USER.NOEXPIRE	USER.NOEXPIRE	Users with Unlimited Password Lifetime	Yes	No	No	No	No	OBP, CIS, STIG
USER.SESSIONS	USER.SESSIONS	Users with Unlimited Concurrent Sessions	No	No	No	No	No	OBP, CIS, STIG
USER.IDLETIME	USER.IDLETIME	Users with Unlimited Session Idle Time	No	No	No	No	No	OBP, STIG
USER.PASSWORDROLLOVER	USER.GPR	Users with Gradual Password Rollover	No	No	No	No	No	ОВР
USER.TEMP	USER.TEMP	Temporary Users	No	No	No	No	No	OBP, STIG
USER.DEV	USER.DEV	Development Users in Production Databases	No	No	No	No	No	OBP, STIG
USER.REPCAT	USER.REPCAT	Advanced Replication Users	No	No	No	No	No	STIG



# Figure DBSAT Target Specific Checks and Recommendations (continued)

USER.AUTHVERSION	USER.AUTHVERS	Minimum Client Authentication Version	No	No	N/A	N/A	No	OBP, STIG
PRIV.ACCESSVERIFIERS	PRIV.PASSWD	Access to Password Verifier Tables	No	No	No	No	No	OBP, CIS
PRIV.SYSADMIN	PRIV.ADMIN	Users with Administrative SYS* Privileges	No	No	N/A	N/A	No	OBP, STIG
PRIV.DBA	PRIV.DBA	Users with DBA Role	No	No	No	No	No	OBP, CIS, STIG
PRIV.BIGROLES	PRIV.BIGROLES	Users with Powerful Roles	No	No	No	No	No	OBP, CIS, STIG
PRIV.SYSTEM	PRIV.SYSTEM	System Privilege Grants	No	No	No	No	No	OBP, CIS, STIG
PRIV.SYSPUBLIC	PRIV.SYSPUB	System Privileges Granted to PUBLIC	No	No	No	No	No	OBP, STIG
PRIV.ROLEPUBLIC	PRIV.ROLEPUB	Roles Granted to PUBLIC	No	No	No	No	No	OBP, STIG
PRIV.COLPUBLIC	PRIV.COLPUB	Column Privileges Granted to PUBLIC	No	No	No	No	No	ОВР
PRIV.OBJPUBLIC	PRIV.OBJPUBLIC	Objects accessible by PUBLIC	No	No	No	No	No	OBP, STIG
PRIV.ENCRYPTPACKAGEPUBLIC	7.0	Encryption Packages Granted to PUBLIC	New	N/A	No	No	No	CIS
PRIV.JOBSCHPACKAGEPUBLIC	-	Scheduler Job Packages Granted to PUBLIC	New	N/A	No	No	No	OBP, CIS
PRIV.CREDPACKAGEPUBLIC	5	Credential Package Granted to PUBLIC	New	N/A	No	No	No	CIS
PRIV.FILESYSTEMPACKAGEPUBLIC		File System Packages Granted to PUBLIC	New	N/A	No	No	No	CIS
PRIV.NET PACKAGEPUBLIC	1	Network Packages Granted to PUBLIC	New	N/A	No	No	No	CIS
PRIV.QUERYPACKAGEPUBLIC		SQL Packages Granted to PUBLIC	New	N/A	No	No	No	CIS
PRIV.JAVAPACKAGEPUBLIC	Til .	JAVA Permissions Granted to PUBLIC	New	N/A	No	No	No	CIS
PRIV.ANYSYSTEM	PRIV.DATA	Broad Data Access Privileges	No	No	No	No	No	OBP, CIS
PRIV.ALLROLES	PRIV.ROLES	All Roles	No	No	No	No	No	OBP, CIS



## Figure DBSAT Target Specific Checks and Recommendations (continued)

PRIV.ACCOUNTMGMT	PRIV.ACCT	Account Management Privileges	No	Yes	No	No	No	OBP, STIG
PRIV.ROLEPRIVMGMT	PRIV.MGMT	Role and Privilege Management Privileges	No	Yes	No	No	No	OBP, CIS
PRIV.DBMGMT	PRIV.DBMGMT	Database Management Privileges	No	Yes	No	No	No	OBP, CIS
PRIV.AUDITMGMTPKG	PRIV.AUDMGMT	Audit Management Package	No	Yes	No	No	No	OBP, STIG
PRIV.AUDITMGMT	PRIV.AUDIT	Audit Management Privileges	No	Yes	No	No	No	OBP, CIS, STIG
PRIV.ACCESSAUDITOBJ	PRIV.AUDOBJ	Access to Audit Objects	No	Yes	No	No	No	OBP, STIG
PRIV.ACCESSEXEMPT	PRIV.EXEMPT	Access Control Exemption Privileges	No	Yes	No	No	No	OBP, CIS
PRIV.RESTRICTEDOBJ	PRIV.OBJ	Write Access to Restricted Objects	No	Yes	No	No	No	OBP, STIG
PRIV.IMPERSONATEUSER	PRIV.USER	Users who can Impersonate other users	No	Yes	No	No	No	OBP, CIS
PRIV.EXFILTRATION	PRIV.EXFIL	Privilege for Data Exfiltration in Bulk	No	Yes	Yes	Yes	No	OBP, CIS
PRIV.CBAC	PRIV.CBAC	Code Based Access Control	No	Yes	No	No	No	ОВР
PRIV.JAVAPERMISSIONS	PRIV.JAVA	Java Permissions	No	Yes	N/A	No	No	ОВР

## Figure DBSAT Target Specific Checks and Recommendations (continued)

AUTHZ.DATABASEVAULT	AUTH.DV	Database Vault	No	No	Yes	Yes	No	OBP, STIG, GDPR
AUTHZ.PRIVANALYSIS	AUTH.PRIV	Privilege Analysis	No	No	No	No	No	ОВР
AUTHZ.PASSWORDSCRIPTS	AUTHZ.PASSWORDSCRIPTS	Authentication for Client Scripts	No	No	No	No	No	OBP, STIG
AUTHZ.DATAMASKING	AUTHZ.DATAMASKING	Data Masking	No	No	No	No	No	OBP, STIG, GDPR
AUTHZ.PKI	AUTHZ.PKI	PKI-based Authentication	No	No	No	No	No	STIG
ACCESS.DATAREDACTION	ACCESS.REDACT	Data Redaction	No	No	No	No	No	GDPR
ACCESS.VPD	ACCESS.VPD	Virtual Private Database	No	No	No	No	No	GDPR
ACCESS.RAS	ACCESS.RAS	Real Application Security	No	No	No	No	No	GDPR
ACCESS.LABELSECURITY	ACCESS.OLS	Label Security	No	No	No	No	No	GDPR
ACCESS.TSDP	ACCESS.TSDP	Transparent Sensitive Data Protection (TSDP)	No	No	No	No	No	OBP
AUDIT.ENABLED	AUDIT.RECORDS	Audit Records	No	No	Yes	Yes	Yes	OBP, CIS, STIG, GDPR
AUDIT.UNIFIEDPOLICIES	AUDIT.UNIFIED	Unified Audit Policies	No	No	Yes	Yes	Yes	OBP, STIG, GDPR
AUDIT.FGA	AUDIT.FGA	Fine Grained Audit	No	No	No	No	No	OBP, STIG



## Figure DBSAT Target Specific Checks and Recommendations (continued)

AUDIT.ADMINACTIONS	AUDIT.ADMIN	Audit Administrative (SYS*) Users	No	No	N/A	N/A	No	OBP, CIS, STIG
AUDIT.CONNECTIONS	AUDIT.CONN	Audit User Logon and Logoff	No	No	Yes	Yes	No	OBP, CIS
AUDIT.DBMGMT	AUDIT.DBMGMT	Audit Database Management Activities	No	No	Yes	Yes	No	OBP, CIS, STIG
AUDIT.ACCOUNTMGMT	AUDIT.ACCTMGMT	Audit Account Management Activities	No	No	No	No	No	OBP, CIS, STIG
AUDIT.SYSTEMPRIVS	AUDIT.PRIV	Audit System Privileges	No	No	No	No	No	OBP, CIS
AUDIT.ROLESYSTEMPRIVS	AUDIT.ROLE	Audit Roles with System Privileges	No	No	No	No	No	OBP
-	AUDIT.PRIVUSE	Note: Merged with AUDIT.SYSTEMPRIVS	-	5	57.2	5	1.75	-
AUDIT.PRIVMGMT	AUDIT.PRIVMGMT	Audit Privilege Management	No	No	No	No	No	OBP, CIS
AUDIT.STATEMENT	AUDIT.STMT	Audit SQL Statements	No	No	No	No	No	ОВР
AUDIT.SENSITIVEOBJS	AUDIT.OBJ	Audit Object Actions	No	No	No	No	No	ОВР
AUDIT.SYNONYMS	1.51	Audit Synonym Management Activities	New	N/A	No	No	No	OBP
AUDIT.CONDITION	AUDIT.CONDITION	Audit Conditions	No	No	No	No	No	ОВР
AUDIT.SHAREDPROXY	AUDIT.SHAREDPROXY	Audit Shared Accounts	No	No	No	No	No	OBP, STIG
AUDIT.TABLESPACE	AUDIT.TABLESPACE	Audit Storage	No	No	No	No	No	OBP, STIG
AUDIT.CLEANUPJOBS	AUDIT.CLEANUPJOBS	Audit Trail Cleanup	No	No	No	No	No	ОВР
AUDIT.DATAPUMP	AUDIT.DATAPUMP	Audit Data Pump	No	No	No	No	No	ОВР

## Figure DBSAT Target Specific Checks and Recommendations (continued)

AUDIT.STIGPOLICY	AUDIT.STIGPOLICY	Audit STIG Actions	No	No	No	No	No	STIG
AUDIT.DATABASEVAULT	AUDIT.DATABASEVAULT	Audit Database Vault	No	No	No	No	No	ОВР
AUDIT.LABELSECURITY	AUDIT.LABELSECURITY	Audit Label Security	No	No	No	No	No	ОВР
ENCRYPT.TDE	CRYPT.TDE	Transparent Data Encryption	No	Yes	Yes	Yes	Yes	OBP, STIG
ENCRYPT.WALLET	CRYPT.WALLET	Encryption Key Wallet	No	No	N/A	Yes	Yes	OBP, STIG
ENCRYPT.DBFIPS	CRYPT.DBFIPS	FIPS Mode for TDE and DBMS_CRYPTO	No	No	N/A	N/A	No	STIG
ENCRYPT.TLSFIPS	ENCRYPT.TLSFIPS	FIPS mode for TLS	No	No	No	No	No	STIG
CONF.PREAUTHREQUESTURL	9	Pre-Authenticated Request URLs	New	N/A	Yes	No	No	OBP
CONF.AUTHN	USER.PARAM	Authentication Configuration	No	No	No	No	No	OBP, CIS
CONF.DEFAULTPDBOSUSER	-	PDB OS User	New	N/A	No	No	No	OBP, CIS
CONF.CONTROLFILES	CONF.CONTROLFILES	Control files	No	No	Yes	Yes	Yes	OBP, STIG
CONF.REDOLOGS	CONF.REDOLOGS	Redo Log Files	No	No	Yes	Yes	Yes	OBP, STIG
CONF.ARCHIVELOG	CONF.ARCHIVELOG	Archive Log Mode	No	No	Yes	Yes	Yes	OBP, STIG
CONF.BACKUP	CONF.BKUP	Database Backup	No	No	Yes	Yes	No	OBP, STIG
CONF.INSTANCENAME	CONF.INSTNM	Instance Name Check	No	No	No	No	No	OBP, STIG
CONF.SQLFIREWALL	CONF.SQLFIREWALL	SQL Firewall	No	No	No	No	No	OBP
CONF.SYSTEMOBJ	CONF.SYSOBJ	Access to Dictionary Objects	No	No	No	No	No	OBP, CIS, STIG
CONF.READONLYHOME	CONF.READONLYHOME	Read-only ORACLE_HOME	No	No	No	No	No	OBP, STIG
CONF.SQL92SECURITY	CONF.INFER	Inference of Table Data	No	No	Yes	Yes	No	OBP, CIS, STIG



#### Figure DBSAT Target Specific Checks and Recommendations (continued)

CONF.PASSWORDFILE	CONF.PWDFILE	Access to Password File	No	No	N/A	N/A	No	OBP, STIG
CONF.NETWORK	CONF.NETCOM	Network Communication	No	No	No	No	No	OBP, CIS
CONF.EXTERNALOSAUTH	CONF.EXTAUTH	External OS Authentication	No	No	N/A	N/A	No	OBP, CIS, STIG
CONF.DBCOMPONENTS	CONF.DBCOMPONENTS	Unused components	No	No	No	No	No	STIG
CONF.TRIGGERS	CONF.TRIG	Triggers	No	No	No	No	No	OBP
CONF.CONSTRAINTS	CONF.CONST	Disabled Constraints	No	No	No	No	No	OBP
CONF.EXTERNALPROCS	CONF.EXTPROC	External Procedures	No	No	N/A	N/A	No	OBP, CIS, STIG
CONF.JOB	CONF.JOB	Job Details	No	No	No	No	No	OBP, STIG
CONF.SOURCEANALYSIS	CONF.SOURCEANALYSIS	Source Code Analysis	No	No	No	No	No	OBP, STIG
CONF.DIRECTORYOBJ	CONF.DIR	Directory Objects	No	No	Yes	Yes	No	OBP, STIG
CONF.DATABASELINKS	CONF.LINKS	Database Links	No	No	Yes	Yes	No	OBP, CIS, STIG
CONF.NETWORKACL	CONF.NETACL	Network Access Control	No	No	Yes	Yes	No	OBP
CONF.XMLACL	CONF.XMLACL	XML Database Access Control	No	No	N/A	N/A	No	OBP
CONF.FILESYS	CONF.FILESYS	File System Access	No	No	N/A	N/A	No	OBP, CIS
CONF.TRACEFILELIMIT	CONF.TRACE	Trace Files	No	No	N/A	N/A	No	OBP, CIS, STIG

### Figure DBSAT Target Specific Checks and Recommendations (continued)

NET.ENCRYPTION	NET.ENCRYPT	Network Encryption	No	No	N/A	N/A	No	OBP, STIG
NET.INVITEDNODES	NET.CLIENTS	Client Nodes	No	No	N/A	N/A	No	OBP, STIG
NET.CONNECTIONLIMITS	NET.CONLIMITS	Connection Limits Configuration	No	No	No	No	No	STIG
NET.LISTENERCONFIG	NET.COST	Network Listener Configuration	No	No	N/A	N/A	No	OBP, CIS, STIG
NET.LISTENERLOG	NET.LISTENLOG	Listener Logging Control	No	No	N/A	N/A	No	ОВР
OS.INSTALLATIONUSER	OS.INSTALLATIONUSER	Installation Account	No	No	N/A	N/A	No	OBP, STIG
OS.AUTH	OS.AUTH	OS Authentication	No	No	N/A	N/A	No	OBP, STIG
OS.MULTIDB	OS.MULTIDB	Segregation of Production and Development Databases	No	No	N/A	N/A	No	STIG
OS.PMON	OS.PMON	Process Monitor Processes	No	No	N/A	N/A	No	ОВР
OS.AGENT	OS.AGENT	Agent Processes	No	No	N/A	N/A	No	ОВР
OS.LISTENER	OS.LISTEN	Listener Processes	No	No	N/A	N/A	No	STIG
OS.CMANLOCAL	OS.CMANLOCAL	CMAN Remote Admin	No	No	N/A	N/A	No	OBP, STIG
OS.DIAGNOSTICDEST	OS.DIAGNOSTICDEST	Diagnostic Destination	No	No	N/A	N/A	No	OBP, STIG
OS.FILEPERMISSIONS	OS.FILES	File Permissions in ORACLE_HOME	No	No	N/A	N/A	No	OBP, STIG

### Figure DBSAT Target Specific Checks and Recommendations (continued)



<sup>(1) -</sup> Improved the finding rules.

<sup>(2) -</sup> Improved the remarks text.

<sup>(3) -</sup> Improved finding rules and/or remarks to specifically target ADB-S. No - The finding applies but it does not include any change as it was not required. N/A - Finding is not applicable.

<sup>(4) -</sup> Improved finding rules and/or remarks to specifically target AD8-D. No - The finding applies but it does not include any change as it was not required. N/A - Finding is not applicable.

<sup>(5) -</sup> Improved finding rules and/or remarks to specifically target DBCS EE/HP/EP. No - The finding applies but it does not include any change as it was not required.

# Appendix B

You can troubleshoot Oracle Database Security Assessment Tool by using diagnostics and log files.

# **B.1** Enabling DBSAT Diagnostics to diagnose Oracle Database Security Assessment Tool Errors

Output diagnostics, which the DBSAT generates, capture vital information to help you debug errors.

By default, DBSAT suppresses errors that do not impact the report execution. To find details on errors that might affect your report generation, please run dbsat report with the -d option.

#### Example of a run with -d:

```
$ ./dbsat report -n -d orcl
```

Database Security Assessment Tool version 3.1 (Mar 2023)

This tool is intended to assist you in securing your Oracle database system. You are solely responsible for your system and the effect and results of the execution of this tool (including, without limitation, any damage or data loss). Further, the output generated by this tool may include potentially sensitive system configuration data and information that could be used by a skilled attacker to penetrate your system. You are solely responsible for ensuring that the output of this tool, including any generated reports, is handled in accordance with your company's policies.

Traceback (most recent call last): File "<iostream>", line 11865, in <module> File "<iostream>", line 1161, in sec\_feature\_usage IndexError: index out of range: 1

DBSAT Reporter ran successfully.

#### Example of a standard run:

```
$ ./dbsat report -n orcl
```

Database Security Assessment Tool version 3.0

This tool is intended to assist you in securing your Oracle database



system. You are solely responsible for your system and the effect and results of the execution of this tool (including, without limitation, any damage or data loss). Further, the output generated by this tool may include potentially sensitive system configuration data and information that could be used by a skilled attacker to penetrate your system. You are solely responsible for ensuring that

the output of this tool, including any generated reports, is handled in accordance with your company's policies.

DBSAT Reporter ran successfully.

#### B.2 DBSAT Reporter Fails With "No JSON object could be decoded"

If execute on package  ${\tt SYS.DBMS\_SQL}$  was revoked from  ${\tt PUBLIC}$  you can encounter this issue.

```
$ ./dbsat report -a -n orcl
```

Database Security Assessment Tool version 3.0

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... Unable to process input file: orcl.json No JSON object could be decoded Error: Unexpected error occurred while running DBSAT Reporter.

To avoid this error, grant execute privilege on DBMS\_SQL to the DBSAT database user (and not use PUBLIC privilege) used in dbsat collect  $<user>@<service_name><output-file>$ 

```
SQL> grant execute on sys.dbms sql to <user> ;
```

Run dbsat collect again to ensure the data is collected appropriately and then run the report.

```
./dbsat collect <user>@<service_name> <output-file>
./dbsat report <output-file>
```

Note: make sure JSON is not invalid or corrupt. Review the json file and/or run the collector.

**B.3 DBSAT Reporter Fails - Generic** 



Occasionally, the source of the issue affecting the DBSAT report's successful execution is present in the collector-generated file. As a troubleshooting step, you can open the file (extract from the zip file) generated by DBSAT collect and search the file for errors.

#### **B.4 Issues running DBSAT on AIX platforms**

AIX default shell is the Korn shell (ksh). DBSAT needs to run under the bash shell. You can either change it to bash or install it. DBSAT fails to run under other shells. As an example, if you do not have bash shell installed on AIX, and you try to run DBSAT, you can encounter the following:

```
oraprod>./dbsat
ksh: ./dbsat: not found
oraprod>pwd
/home/oraprod/dbsat300
```

At this point, you can install bash on AIX or run DBSAT collect remotely. You can execute DBSAT from another server with bash (e.g., a linux server), reaching the database running on AIX:

```
./dbsat collect <user>@<service name> <output-file>
```

When collecting from a remote server, DBSAT will not include Operating System-related findings.

# Appendix C

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# XIsxWriter, Version: 2.0

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Oracle Database Database Security Assessment Tool User Guide , Release 3.1.0

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