

```
nsibbing@nsibbing-lnx:[~]$ sqlplus sys@18c as sysdba
```

```
SQL*Plus: Release 12.2.0.1.0 Production on Tue May 8 14:45:33 2018
```

```
Copyright (c) 1982, 2016, Oracle. All rights reserved.
```

```
Enter password:
```

```
Connected to:
```

```
Oracle Database 18c Enterprise Edition Release 18.0.0.0.0 -  
Production
```

```
SQL> alter user system no authentication;
```

```
User altered.
```

```
SQL> connect system@18c
```

```
Enter password:
```

```
ERROR:
```

```
ORA-01017: invalid username/password; logon denied
```

```
Warning: You are no longer connected to ORACLE.
```

Listing 1

```
SQL> create user nsibbing identified by welcome1;
```

```
User created.
```

```
SQL> grant create session to nsibbing;
```

```
Grant succeeded.
```

```
SQL> alter user system grant connect through nsibbing;
```

```
User altered.
```

Listing 2

```
SQL> connect nsibbing[system]@18c_cdb
Enter password:
Connected.

SQL> show user
USER is "SYSTEM"

SQL> select SYS_CONTEXT('USERENV','PROXY_USER') PROXY_USER,
SYS_CONTEXT('USERENV','SESSION_USER') SESSION_USER from dual;

PROXY_USER          SESSION_USER
-----
NSIBBING            SYSTEM

SQL>
```

Listing 3

```
##### ORACLE #####

[oracle@tde]$ sqlplus / as sysdba

SQL*Plus: Release 18.0.0.0.0 Production on Mon Apr 16 07:50:19 2018
Version 18.1.0.0.0

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Connected to:
Oracle Database 18c Enterprise Edition Release 18.0.0.0.0 -
Production
Version 18.1.0.0.0

SQL> show parameter audit
```

NAME	TYPE	VALUE
------	------	-------

```

-----
audit_file_dest          string          /u01/app/oracle/admin/cdb1/adu
                        mp
audit_sys_operations     boolean        TRUE
audit_syslog_level       string
audit_trail              string          DB
unified_audit_sga_queue_size integer         1048576
unified_audit_systemlog   string

```

```

SQL> alter system set UNIFIED_AUDIT_SYSTEMLOG = 'LOCAL6.NOTICE'
scope=spfile;

```

System altered.

Listing 4

```

####ROOT####

```

```

[root@tde]# vi /etc/rsyslog.conf

```

```

.....

```

```

# Everybody gets emergency messages

```

```

*.emerg                                     *
```

```

#ORACLE UNIFIED AUDITING

```

```

local6.notice

```

```

/var/log/audit_oracle.log

```

```

# Save news errors of level crit and higher in a special file.

```

```

uucp,news.crit

```

```

/var/log/spooler

```

```

.....

```

```

[root@tde]# service rsyslog restart

```

```

Shutting down system logger:                [ OK ]

```

```

Starting system logger:                      [ OK ]

```

```
[root@tde]#
```

Listing 5

```
##### ORACLE #####
```

```
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> startup
ORACLE instance started.
```

```
Total System Global Area 2113926528 bytes
Fixed Size          8897920 bytes
Variable Size       603979776 bytes
Database Buffers 1493172224 bytes
Redo Buffers        7876608 bytes
Database mounted.
Database opened.
SQL> show parameter audit
```

NAME	TYPE	VALUE
audit_file_dest	string	/u01/app/oracle/admin/cdb1/du mp
audit_sys_operations	boolean	TRUE
audit_syslog_level	string	
audit_trail	string	DB
unified_audit_sga_queue_size	integer	1048576
unified_audit_systemlog	string	LOCAL6.NOTICE

```
SQL>
```

Listing 6

```
##### ROOT #####
```

```
[root@tde]# ls -la /var/log/audit_oracle.log
-rw----- 1 root root 0 Apr 16 08:03 /var/log/audit_oracle.log
```

Listing 7

```
##### ORACLE #####
```

```
SQL> alter pluggable database pdb1 close;
```

```
Pluggable database altered.
```

```
SQL>
```

Listing 8

```
##### ROOT #####
```

```
[root@tde]# vi /var/log/audit_oracle.log
```

```
Apr 16 08:10:03 tde Oracle Unified Audit[26869]: LENGTH: '157'  
TYPE:"4" DBID:"946366664" SESID:"1095071156" CLIENTID:"" ENTRYID:"1"  
STMTID:"8" DBUSER:"SYS" CURUSER:"SYS" ACTION:"227" RETCODE:"0"  
SCHEMA:"" OBJNAME:"PDB1"  
Apr 16 08:20:01 tde Oracle Unified Audit[29337]: LENGTH: '157'  
TYPE:"4" DBID:"946366664" SESID:"3301646103" CLIENTID:"" ENTRYID:"1"  
STMTID:"7" DBUSER:"SYS" CURUSER:"SYS" ACTION:"227" RETCODE:"0"  
SCHEMA:"" OBJNAME:"PDB1"
```

Listing 9

```
##### ORACLE PDB1 #####
```

```
SQL> alter pluggable database pdb1 open;
```

Pluggable database altered.

SQL>

SQL> alter session set container=pdb1;

Session altered.

SQL> show parameter audit

NAME	TYPE	VALUE
audit_file_dest	string	/u01/app/oracle/admin/cdb1/du mp
audit_sys_operations	boolean	TRUE
audit_syslog_level	string	
audit_trail	string	DB
unified_audit_sga_queue_size	integer	1048576
unified_audit_systemlog	string	

SQL> alter system set UNIFIED_AUDIT_SYSTEMLOG = 'LOCAL6.NOTICE'
scope=spfile;

System altered.

SQL> alter pluggable database pdb1 close;

Pluggable database altered.

SQL> alter pluggable database pdb1 open;

Pluggable database altered.

SQL> show parameter audit

NAME	TYPE	VALUE
audit_file_dest	string	/u01/app/oracle/admin/cdb1/du mp
audit_sys_operations	boolean	TRUE

audit_syslog_level	string	
audit_trail	string	DB
unified_audit_sga_queue_size	integer	1048576
unified_audit_systemlog	string	LOCAL6.NOTICE

Listing 10

```
### ROOT #####

[root@tde]# tail -f /var/log/audit_oracle.log
Apr 16 08:10:03 tde Oracle Unified Audit[26869]: LENGTH: '157'
TYPE:"4" DBID:"946366664" SESID:"1095071156" CLIENTID:"" ENTRYID:"1"
STMTID:"8" DBUSER:"SYS" CURUSER:"SYS" ACTION:"227" RETCODE:"0"
SCHEMA:"" OBJNAME:"PDB1"
Apr 16 08:20:01 tde Oracle Unified Audit[29337]: LENGTH: '157'
TYPE:"4" DBID:"946366664" SESID:"3301646103" CLIENTID:"" ENTRYID:"1"
STMTID:"7" DBUSER:"SYS" CURUSER:"SYS" ACTION:"227" RETCODE:"0"
SCHEMA:"" OBJNAME:"PDB1"
Apr 16 08:26:15 tde Oracle Unified Audit[29337]: LENGTH: '158'
TYPE:"4" DBID:"2646849021" SESID:"3207252084" CLIENTID:""
ENTRYID:"1" STMTID:"4" DBUSER:"SYS" CURUSER:"SYS" ACTION:"227"
RETCODE:"0" SCHEMA:"" OBJNAME:"PDB1"
```

Listing 11

```
##### ORACLE #####

SQL> select * from audit_actions where action=227;

ACTION NAME
-----
227 ALTER PLUGGABLE DATABASE

SQL>
```

Listing 12

```
Apr 16 09:06:50 tde Oracle Unified Audit[11188]: LENGTH: '156'  
TYPE:"4" DBID:"946366664" SESID:"2439550631" CLIENTID:"" ENTRYID:"1"  
STMTID:"1" DBUSER:"SYS" CURUSER:"SYS" ACTION:"100" RETCODE:"1017"  
SCHEMA:"" OBJNAME:""
```

Listing 13

```
SQL> COLUMN OS_USERNAME FORMAT A25  
SQL> COLUMN DBUSERNAME FORMAT A25  
SQL> COLUMN CLIENT_PROGRAM_NAME FORMAT A25  
SQL> COLUMN AUDIT_TYPE FORMAT A25  
SQL> set linesize 1000  
  
SQL> select OS_USERNAME,DBUSERNAME,CLIENT_PROGRAM_NAME,AUDIT_TYPE  
from unified_audit_trail where sessionid=2439550631 and  
statement_id=1;
```

OS_USERNAME	DBUSERNAME	CLIENT_PROGRAM_NAME	AUDIT_TYPE
oracle	SYS	sqlplus@tde (TNS V1-V3)	Standard

```
SQL>
```

Listing 14

```
sqlplus / as sysdba  
CREATE PUBLIC DATABASE LINK my_public_dblink CONNECT TO cloneadmin  
identified by welcome1 using 'TDE1';
```

Listing 15

```
SQL> select PASSWORDX from SYS.LINK$;  
  
PASSWORDX
```



```
-----  
07AAA610A6F5486F00E56453E8963C05BCDBE509D682E23FB8662FC67A764571552C  
50ECBA4E8A243F386398E003C6EF997CC7AA96E592DF43FA3802CEB40F93E8ECBC57  
D9AA72A672086B7788119A965B5C95D663736CBC1D9DE2B3849015E69058DF79907B  
27034ECA3424D12D82CBDD71566A8CD86802A1A51203760D550
```

Listing 16

```
[oracle]$ vi $ORACLE_HOME/network/admin/sqlnet.ora  
ENCRYPTION_WALLET_LOCATION =  
  (SOURCE =  
    (METHOD = FILE)  
    (METHOD_DATA =  
      (DIRECTORY = /u01/oracle/db/orcl/wallet)  
    )  
  )
```

Listing 17

```
[oracle]$ sqlplus / as syskm  
  
SQL*Plus: Release 18.0.0.0.0 Production on Tue Apr 3 09:55:27 2018  
Version 18.1.0.0.0  
  
Copyright (c) 1982, 2017, Oracle. All rights reserved.  
  
Connected to:  
Oracle Database 18c Enterprise Edition Release 18.0.0.0.0 -  
Production  
Version 18.1.0.0.0  
SQL> ADMINISTER KEY MANAGEMENT CREATE KEYSTORE  
'/u01/oracle/db/orcl/wallet' IDENTIFIED BY password;  
ADMINISTER KEY MANAGEMENT CREATE KEYSTORE  
'/u01/oracle/db/orcl/wallet'  
keystore altered.
```

```
SQL> ADMINISTER KEY MANAGEMENT SET KEYSTORE OPEN IDENTIFIED BY
password;
```

```
keystore altered.
```

Listing 18

```
SQL> ADMINISTER KEY MANAGEMENT SET ENCRYPTION KEY IDENTIFIED BY
password WITH BACKUP;
```

```
keystore altered.
```

Listing 19

```
SQL> SELECT KEY_ID, TAG, KEY_USE FROM V$ENCRYPTION_KEYS;
```

KEY_ID	TAG	KEY_USE
AXiF8qGCy08Lv4qa1rfHa74AAAAAAAAAAAAAAAAAAAAAAAAAAAA	TDE	IN PDB

Listing 20

```
SQL> ALTER DATABASE DICTIONARY ENCRYPT CREDENTIALS;
```

```
Database dictionary altered
```

Listing 21

```
sqlplus / as sysdba
```

```
SQL> select PASSWORDX from SYS.LINK$;
```

```
PASSWORDX
```

```
-----
```

```
0806FD96C46FD721EA7D218432F2E59DBC4C13242F50551C0F1BDDCE3879D2893254
2298B98F542F48EE084B03AC1ACF0C2ABAB2F13B716A57B39EEBB2A654745D2DE3D7
35A9CC864CD18563ECEC2381B78E621163BF85A95E3A2A8616F13D8A57269CAE5A5D
443342805FAC0C3B28FEB0968D31F07C3EB8A3D62D788E7B58D
```

Listing 22

```
07AAA610A6F5486F00E56453E8963C05BCDBE509D682E23FB8662FC67A764571552C
50ECBA4E8A243F386398E003C6EF997CC7AA96E592DF43FA3802CEB40F93E8ECBC57
D9AA72A672086B7788119A965B5C95D663736CBC1D9DE2B3849015E69058DF79907B
27034ECA3424D12D82CBDD71566A8CD86802A1A51203760D550
```

<>

```
0806FD96C46FD721EA7D218432F2E59DBC4C13242F50551C0F1BDDCE3879D2893254
2298B98F542F48EE084B03AC1ACF0C2ABAB2F13B716A57B39EEBB2A654745D2DE3D7
35A9CC864CD18563ECEC2381B78E621163BF85A95E3A2A8616F13D8A57269CAE5A5D
443342805FAC0C3B28FEB0968D31F07C3EB8A3D62D788E7B58D
```

Listing 23

```
sqlplus / as syskm
```

```
SQL> ALTER DATABASE DICTIONARY REKEY CREDENTIALS;
```

```
Database dictionary altered
```

Listing 24

```
sqlplus / as sysdba
```

```
SQL> select PASSWORDX from SYS.LINK$;
```

```
PASSWORDX
```

```
-----
```

```
08BD87AC23FFF3D2B189AF71B2928ADE698730248759F8A4D098355A81736CE10F74
E78BC325B3FC05F1A3D863CB035619E7C16393986DC74F1D035359283A906EF934C0
```

```
2BC1832461D81541733C536C38632CF2E3AB131228AC9A4E46CF45572CEE5A212271
D8FFB11A7D49940FC2056EED4F385D962C2B114F2304F5F0EE0
```

Listing 25

```
0806FD96C46FD721EA7D218432F2E59DBC4C13242F50551C0F1BDDCE3879D2893254
2298B98F542F48EE084B03AC1ACF0C2ABAB2F13B716A57B39EEBB2A654745D2DE3D7
35A9CC864CD18563ECEC2381B78E621163BF85A95E3A2A8616F13D8A57269CAE5A5D
443342805FAC0C3B28FEB0968D31F07C3EB8A3D62D788E7B58D
<>
08BD87AC23FFF3D2B189AF71B2928ADE698730248759F8A4D098355A81736CE10F74
E78BC325B3FC05F1A3D863CB035619E7C16393986DC74F1D035359283A906EF934C0
2BC1832461D81541733C536C38632CF2E3AB131228AC9A4E46CF45572CEE5A212271
D8FFB11A7D49940FC2056EED4F385D962C2B114F2304F5F0EE0
```

Listing 26

```
sqlplus / as syskm
SQL> ADMINISTER KEY MANAGEMENT SET KEYSTORE CLOSE IDENTIFIED BY
password;

keystore altered.
```

Listing 27

```
sqlplus / as sysdba

SQL> SELECT SYSDATE from DUAL@MY_PUBLIC_DBLINK;
SELECT SYSDATE from DUAL@MY_PUBLIC_DBLINK
ERROR at line 1:
ORA-28365: wallet is not open
```

Listing 28

```
sqlplus / as syskm
SQL> ADMINISTER KEY MANAGEMENT SET KEYSTORE OPEN IDENTIFIED BY
password;
```

keystore altered.

```
SQL> SELECT SYSDATE from DUAL@MY_PUBLIC_DBLINK;
```

```
SYSDATE
-----
14-MAR-18
```

Listing 29

```
sqlplus / as syskm
SQL> ALTER DATABASE DICTIONARY DELETE CREDENTIALS KEY;
```

Database dictionary altered

Listing 30

```
sqlplus / as sysdba
SQL> SELECT SYSDATE from DUAL@MY_PUBLIC_DBLINK;
SELECT SYSDATE from DUAL@MY_PUBLIC_DBLINK
```

```
ERROR at line 1:
ORA-28449: cannot use an invalidated database link
```

Listing 31

```
SQL> ALTER PUBLIC DATABASE LINK my_public_dblink CONNECT TO
cloneadmin identified by welcome1;
```

Database link altered.

```
SQL> SELECT SYSDATE from DUAL@MY_PUBLIC_DBLINK;
```

```
SYSDATE  
-----  
14-MAR-18
```

Listing 32

```
wallet-root/tde/ewallet.p12  
wallet-root/tde/ewallet_2016120918333644.p12  
wallet-root/3FD1C95B48205D0FE053C5A0E40AEF8C/tde/ewallet.p12  
wallet-  
root/3FD1C95B48205D0FE053C5A0E40AEF8C/tde/ewallet_2016110918331622.p  
12  
wallet-  
root/3FD1C95B48205D0FE053C5A0E40AEF8C/tde/ewallet_2016110918332363.p  
12
```

Listing 33

```
[oracle@TDE cdb1]$ sqlplus / as sysdba  
  
SQL*Plus: Release 18.0.0.0.0 Production on Thu Apr 5 12:32:16 2018  
Version 18.1.0.0.0  
  
Copyright (c) 1982, 2017, Oracle. All rights reserved.  
  
Connected to:  
Oracle Database 18c Enterprise Edition Release 18.0.0.0.0 -  
Production  
Version 18.1.0.0.0  
  
SQL> ALTER SYSTEM SET WALLET_ROOT="/home/oracle/keystore_root"  
SCOPE=SPFILE;
```

System altered.

```
SQL> SHUTDOWN IMMEDIATE;
```

Database closed.

Database dismounted.

ORACLE instance shut down.

```
SQL> STARTUP
```

ORACLE instance started.

Total System Global Area 4280905608 bytes

Fixed Size 8904584 bytes

Variable Size 2332033024 bytes

Database Buffers 1593835520 bytes

Redo Buffers 346132480 bytes

Database mounted.

Database opened.

```
SQL> show parameter wallet
```

NAME	TYPE	VALUE
wallet_root	string	/home/oracle/keystore_root

```
SQL>
```

Listing 34

```
SQL> ALTER SYSTEM SET
```

```
TDE_CONFIGURATION="KEYSTORE_CONFIGURATION=FILE" SCOPE=both;
```

System altered.

```
SQL> SHOW PARAMETER TDE_CONFIGURATION
```

NAME	TYPE	VALUE
tde_configuration	string	KEYSTORE_CONFIGURATION=FILE

Listing 35

SQL> show pdbs

CON_ID	CON_NAME	OPEN MODE	RESTRICTED
2	PDB\$SEED	READ ONLY	NO
3	PDB1	READ WRITE	NO
4	PDB2	READ WRITE	NO

SQL> SELECT CON_ID, KEYSTORE_MODE, WRL_PARAMETER, WRL_TYPE, STATUS
FROM V\$ENCRYPTION_WALLET;

CON_ID	KEYSTORE	WRL_PARAMETER	WRL_TYPE	STATUS
1	NONE		FILE	CLOSED
2	UNITED		FILE	CLOSED
3	UNITED		FILE	CLOSED
4	UNITED		FILE	CLOSED

Listing 36

SQL> alter session set container=pdb1;

Session altered.

SQL> SELECT KEYSTORE_MODE, WRL_PARAMETER, WRL_TYPE, STATUS FROM
V\$ENCRYPTION_WALLET;

KEYSTORE	WRL_PARAMETER	WRL_TYPE	STATUS
UNITED			FILE
	OPEN_NO_MASTER_KEY		


```
SQL> ALTER SYSTEM SET
TDE_CONFIGURATION="KEYSTORE_CONFIGURATION=FILE" SCOPE=both;
```

System altered.

```
SQL> SELECT KEYSTORE_MODE, WRL_PARAMETER, WRL_TYPE, STATUS FROM
V$ENCRYPTION_WALLET;
```

```
KEYSTORE WRL_PARAMETER
WRL_TYPE          STATUS
-----
ISOLATED
/home/oracle/keystore_root/691A1250F7C14EB5E0530201000A7EA2/tde/
FILE             NOT_AVAILABLE
```

```
SQL> ADMINISTER KEY MANAGEMENT CREATE KEYSTORE IDENTIFIED BY
welcome2;
```

keystore altered.

```
SQL> SELECT KEYSTORE_MODE, WRL_PARAMETER, WRL_TYPE, STATUS FROM
V$ENCRYPTION_WALLET;
```

```
KEYSTORE WRL_PARAMETER
WRL_TYPE          STATUS
-----
ISOLATED
/home/oracle/keystore_root/691A1250F7C14EB5E0530201000A7EA2/tde/
FILE             OPEN_NO_MASTER_KEY
```

```
SQL> ADMINISTER KEY MANAGEMENT SET KEY IDENTIFIED BY "welcome2" WITH
BACKUP;
```

keystore altered.

```
SQL> SELECT KEYSTORE_MODE, WRL_PARAMETER, WRL_TYPE, STATUS FROM
V$ENCRYPTION_WALLET;
```

```
KEYSTORE WRL_PARAMETER
WRL_TYPE      STATUS
-----
ISOLATED
/home/oracle/keystore_root/691A1250F7C14EB5E0530201000A7EA2/tde/
FILE          OPEN
SQL>
```

Listing 37

```
SQL> set linesize 1000
SQL> col WRL_PARAMETER FORMAT A75
SQL> col WRL_TYPE FORMAT A15
SQL> SELECT KEYSTORE_MODE, WRL_PARAMETER, WRL_TYPE, STATUS FROM
V$ENCRYPTION_WALLET;

KEYSTORE WRL_PARAMETER
WRL_TYPE      STATUS
-----
NONE   /home/oracle/keystore_root/tde/                               FILE
        OPEN
UNITED                                         FILE
        OPEN
ISOLATED
/home/oracle/keystore_root/691A1250F7C14EB5E0530201000A7EA2/tde/
FILE          CLOSED
ISOLATED
/home/oracle/keystore_root/691A836C2EB06E3AE0530201000AA91E/tde/
FILE          OPEN
SQL>
```

Listing 38

```
[oracle@tde keystore_root]$ pwd
/home/oracle/keystore_root
[oracle@tde keystore_root]$ ll
total 12
drwxr-x--- 3 oracle oinstall 4096  5. Apr 12:47
691A1250F7C14EB5E0530201000A7EA2
drwxr-x--- 3 oracle oinstall 4096  5. Apr 13:04
691A836C2EB06E3AE0530201000AA91E
drwxr-x--- 2 oracle oinstall 4096  5. Apr 13:20 tde
[oracle@tde keystore_root]$
```

Listing 39