Protect your Database with SQL Firewall in 23c

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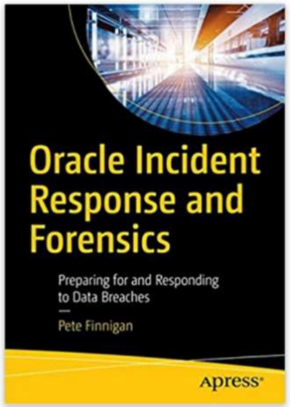


Oracle Incident Response and Forensics

Preparing for and Responding to Data Breaches

Pete Finnigan

Apress

Pete Finnigan – Background, Who Am I?

- Oracle Security specialist and researcher
- CEO and founder of PeteFinnigan.com Limited in February 2003
- Writer of the longest running Oracle security blog
- Author of the Oracle Security step-by-step guide and “Oracle Expert Practices”, “Oracle Incident Response and Forensics” books
- Oracle ACE for security
- Member of the OakTable
- Speaker at various conferences
  - UKOUG, PSOUG, BlackHat, more..
- Published many times, see
  - http://www.petefinnigan.com for links
- Influenced industry standards
  - And governments

Agenda

- What is the SQL Firewall
- Why use the SQL Firewall
- Set up the data
- Set up SQL Firewall and Training
- Testing
- Hacking
- SQL Firewall Management

Section

What is the SQL Firewall?

What is the SQL Firewall

- **"The SQL Firewall blocks non-authorized SQL or PL/SQL"**
- We can expand that to **"The SQL Firewall monitors and / or blocks non-authorized SQL or PL/SQL"**
- This started as the Secerno product and became Oracles database firewall
- Now embedded in the database SQL engine in 23c

Section

Why Use the SQL Firewall?

Database Security

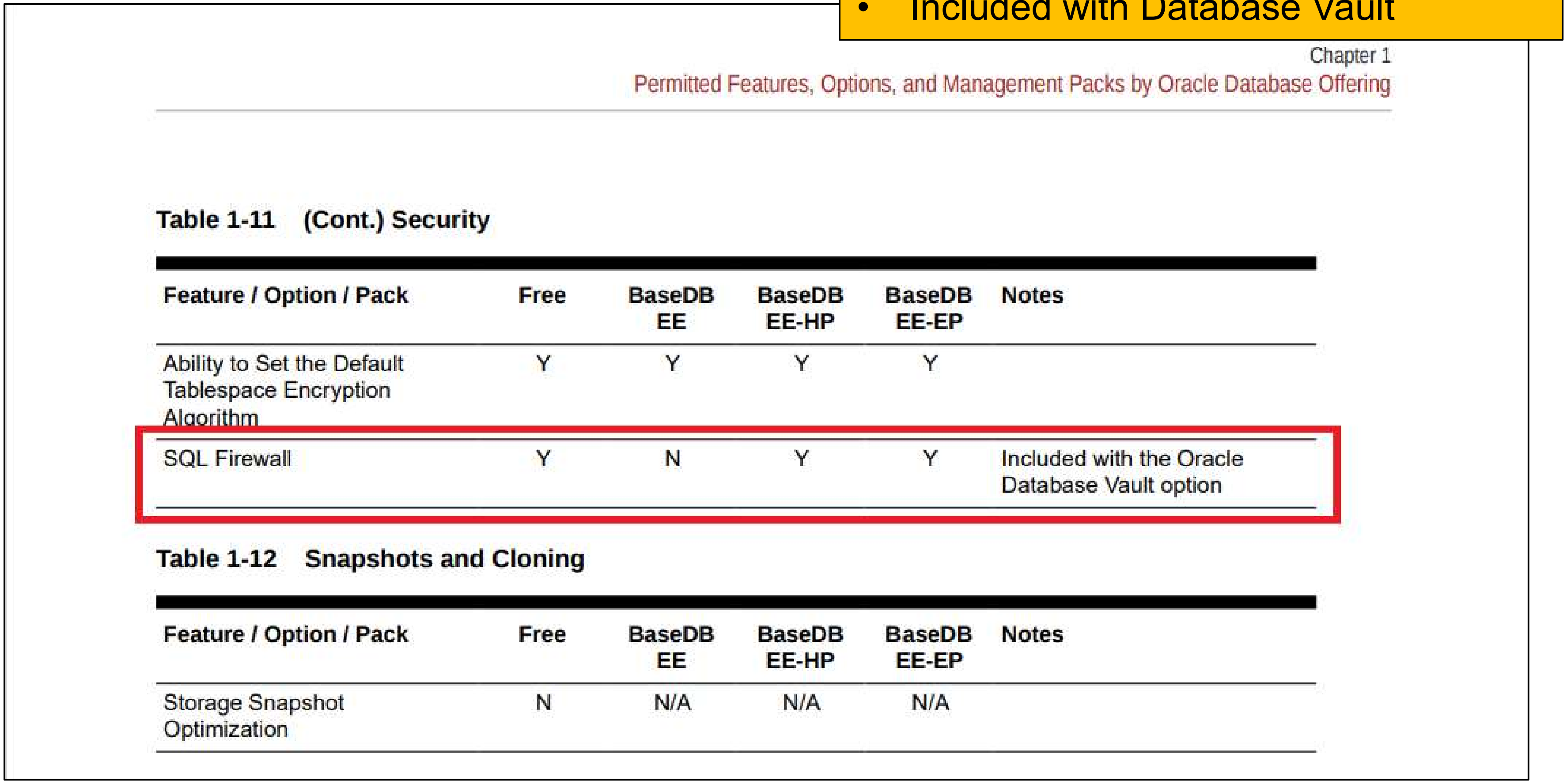
- Security patches and database Hardening
- Data security
  - Access controls
  - User controls – least rights
  - Data access controls
- Audit trails
- Secure coding
- Context based security (DV, VPD, TSDP,…)
- **Firewalls, DAM, IDS, IPS, …**

SQL Firewall is the Last Step

- We must implement all of the other layers of data security to protect data first
- SQL Firewall is the final layer on top of other data security and auditing
- We should not rely just on the SQL Firewall
- It is based on “good/bad” SQL
  - We must tell it what is good

License?

- https://docs.oracle.com/en/database/oracle/oracle-database/23/dblic/database-licensing-information-user-manual.pdf
- Not in base cloud EE
- Included with Database Vault



Chapter 1
Permitted Features, Options, and Management Packs by Oracle Database Offering

Table 1-11 (Cont.) Security

Feature / Option / Pack	Free	BaseDB EE	BaseDB EE-HP	BaseDB EE-EP	Notes
Ability to Set the Default Tablespace Encryption Algorithm	Y	Y	Y	Y	
SQL Firewall	Y	N	Y	Y	Included with the Oracle Database Vault option

Table 1-12 Snapshots and Cloning

Feature / Option / Pack	Free	BaseDB EE	BaseDB EE-HP	BaseDB EE-EP	Notes
Storage Snapshot Optimization	N	N/A	N/A	N/A	

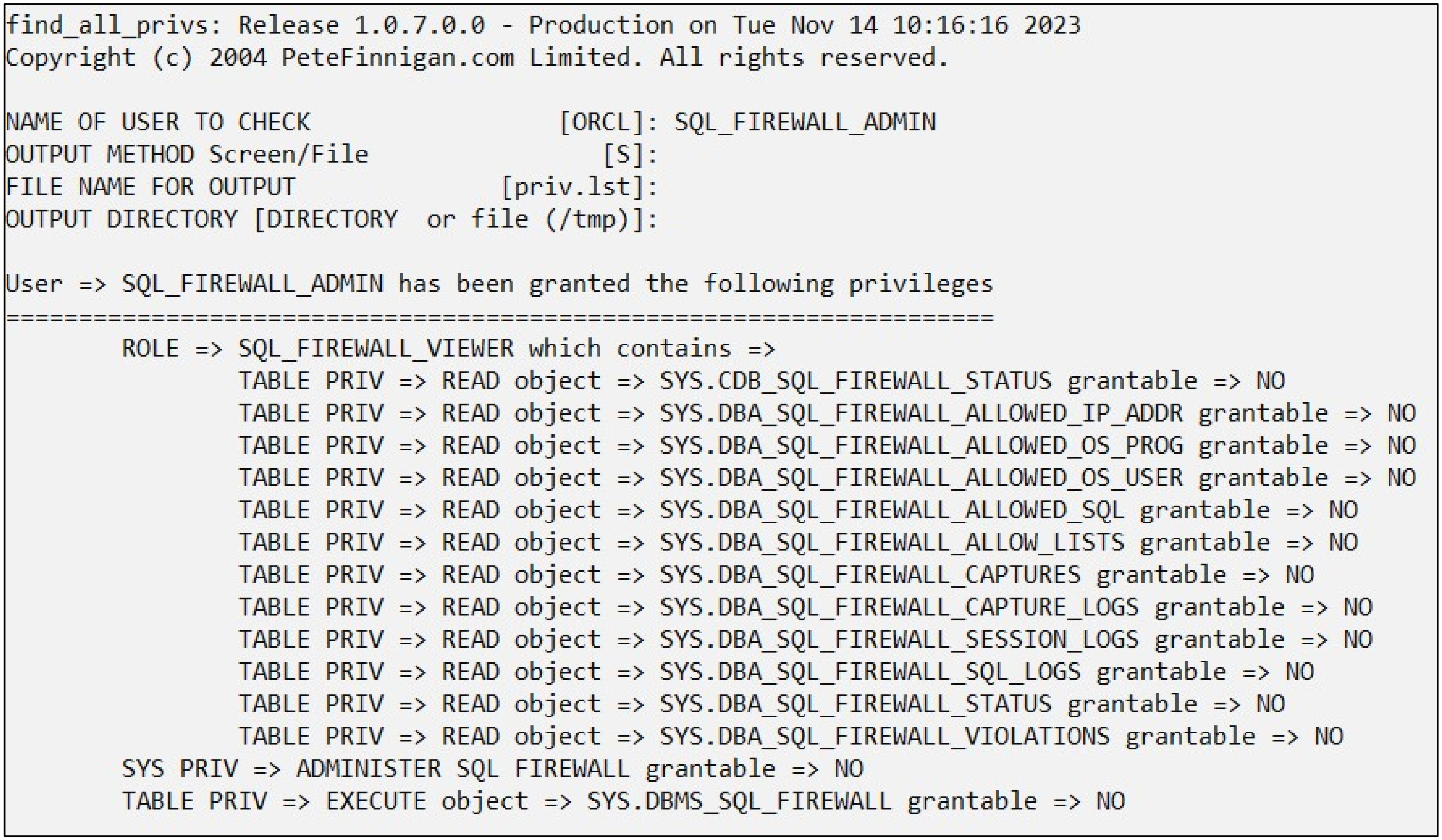
Section

Set up the Data

SQL Firewall Permissions - 1

- System Privilege
  - ADMINISTER SQL FIREWALL
- PL/SQL Package
  - DBMS_SQL_FIREWALL
- Views
  - dba_sql_firewall_violations, dba_sql_firewall_allowed_sql, ….
- Roles
  - SQL_FIREWALL_ADMIN
  - SQL_FIREWALL_VIEWER

SQL Firewall Permissions - 2



```
find_all_privs: Release 1.0.7.0.0 - Production on Tue Nov 14 10:16:16 2023
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NAME OF USER TO CHECK                 [ORCL]: SQL_FIREWALL_ADMIN
OUTPUT METHOD Screen/File                [S]:
FILE NAME FOR OUTPUT              [priv.lst]:
OUTPUT DIRECTORY [DIRECTORY  or file (/tmp)]:

User => SQL_FIREWALL_ADMIN has been granted the following privileges
====================================================================
        ROLE => SQL_FIREWALL_VIEWER which contains =>
                TABLE PRIV => READ object => SYS.CDB_SQL_FIREWALL_STATUS grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_ALLOWED_IP_ADDR grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_ALLOWED_OS_PROG grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_ALLOWED_OS_USER grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_ALLOWED_SQL grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_ALLOW_LISTS grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_CAPTURES grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_CAPTURE_LOGS grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_SESSION_LOGS grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_SQL_LOGS grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_STATUS grantable => NO
                TABLE PRIV => READ object => SYS.DBA_SQL_FIREWALL_VIOLATIONS grantable => NO
        SYS PRIV => ADMINISTER SQL FIREWALL grantable => NO
        TABLE PRIV => EXECUTE object => SYS.DBMS_SQL_FIREWALL grantable => NO
```

- sf_create_users.sql
- sf_create_sf.sql
- sf_run_vm.sql

Set up Test Data

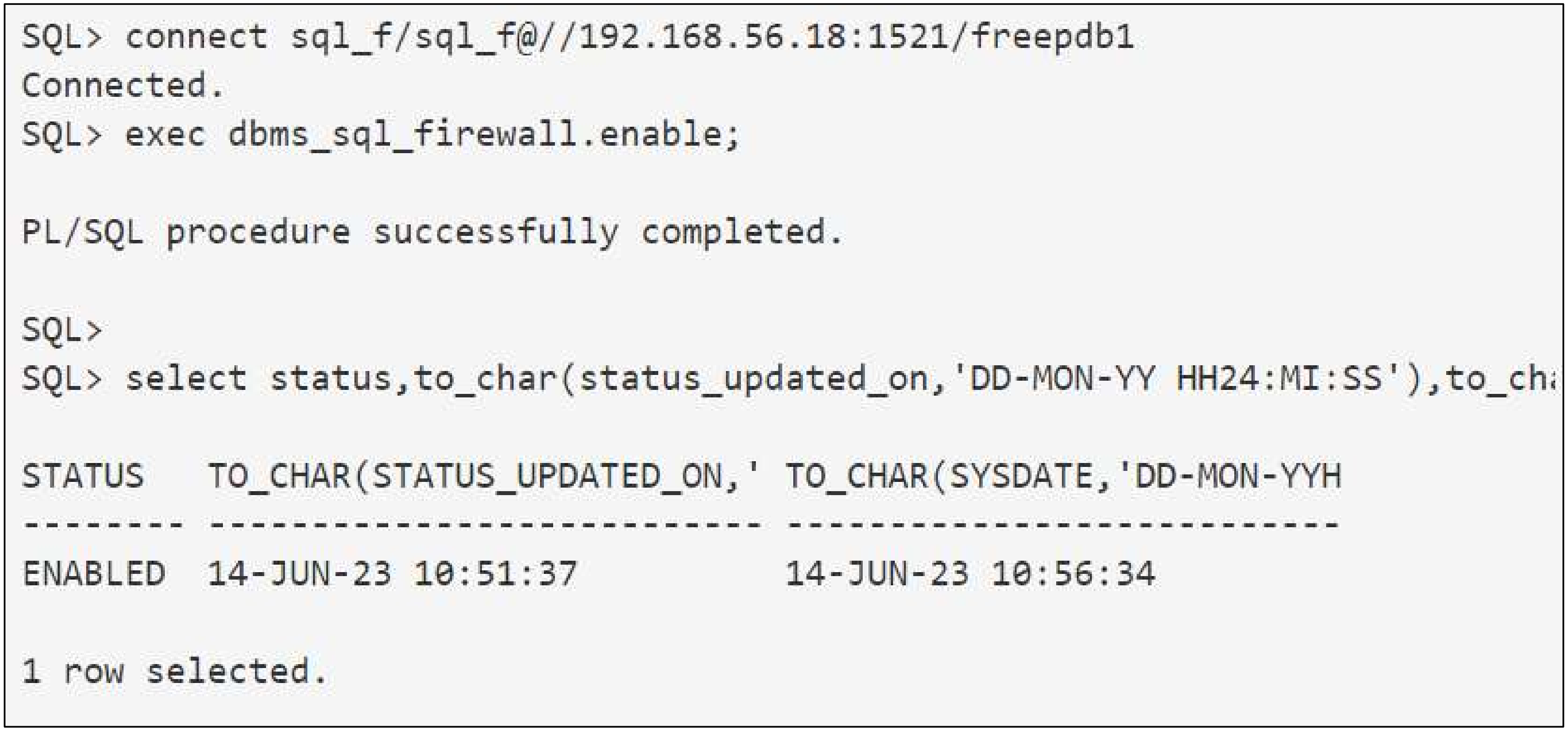
- Create a schema ORABLOG to own some tables, data and PL/SQL Code
- Create a connection user VM to access data
- Make the grants
- Create a SQL Firewall Admin user
- Run some sample SQL and PL/SQL

Section

Set up SQL Firewall and Training

- sf_enable.sql

Enable the SQL Firewall



```
SQL> connect sql_f/sql_f@//192.168.56.18:1521/freepdb1
Connected.
SQL> exec dbms_sql_firewall.enable;

PL/SQL procedure successfully completed.

SQL>
SQL> select status,to_char(status_updated_on,'DD-MON-YY HH24:MI:SS'),to_ch

STATUS   TO_CHAR(STATUS_UPDATED_ON,' TO_CHAR(SYSDATE,'DD-MON-YYH
-------- --------------------------- ---------------------------
ENABLED  14-JUN-23 10:51:37          14-JUN-23 10:56:34

1 row selected.
```

- sf_capture.sql
- sf_run_vm.sql
- sf_stop.sql
- sf_log.sql

Set up the Capture

- We need to teach the SQL Firewall what good SQL and PL/SQL looks like
- Create a capture for the user VM
- Run sample (ALL) business logic
- Turn off the capture
- Review the capture logs
- NOTE: Some items we did not do directly
- **Do not "teach" the SQL Firewall BAD SQL**

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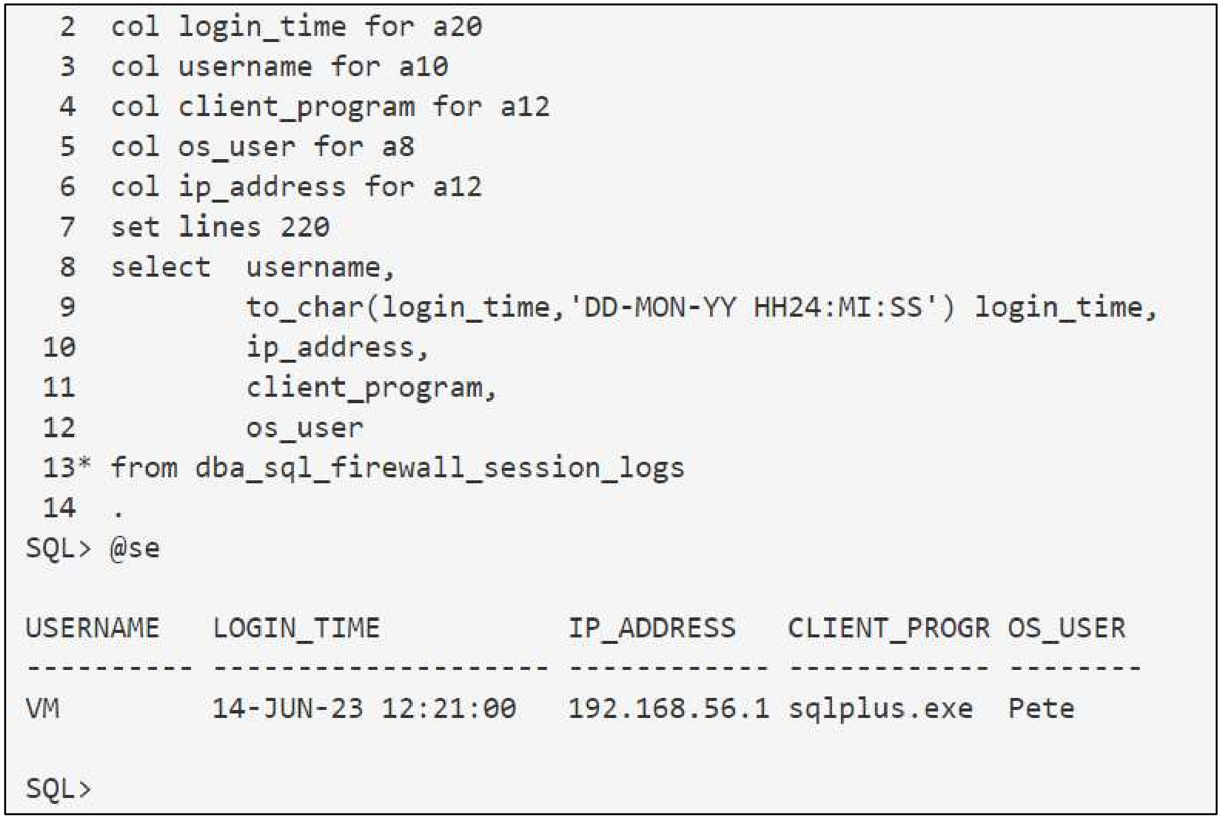
- sf_se_log.sql

Session Logs

- This shows the SQL sessions



```
  2  col login_time for a20
  3  col username for a10
  4  col client_program for a12
  5  col os_user for a8
  6  col ip_address for a12
  7  set lines 220
  8  select  username,
  9          to_char(login_time,'DD-MON-YY HH24:MI:SS') login_time,
 10          ip_address,
 11          client_program,
 12          os_user
 13* from dba_sql_firewall_session_logs
 14  .
SQL> @se

USERNAME   LOGIN_TIME           IP_ADDRESS   CLIENT_PROGR OS_USER
---------- -------------------- ------------ ------------ --------
VM         14-JUN-23 12:21:00   192.168.56.1 sqlplus.exe  Pete

SQL>
```

- sf_allow.sql

Create the Allow List

- Generate the allow list from the capture list
- Review the SQL and PL/SQL
- We can adjust the list now or in the future
  - I will not make changes for expediency
- Enable the allow list for VM
- **The SQL Firewall works on "good" SQL but we cannot operate from the reverse stand point**

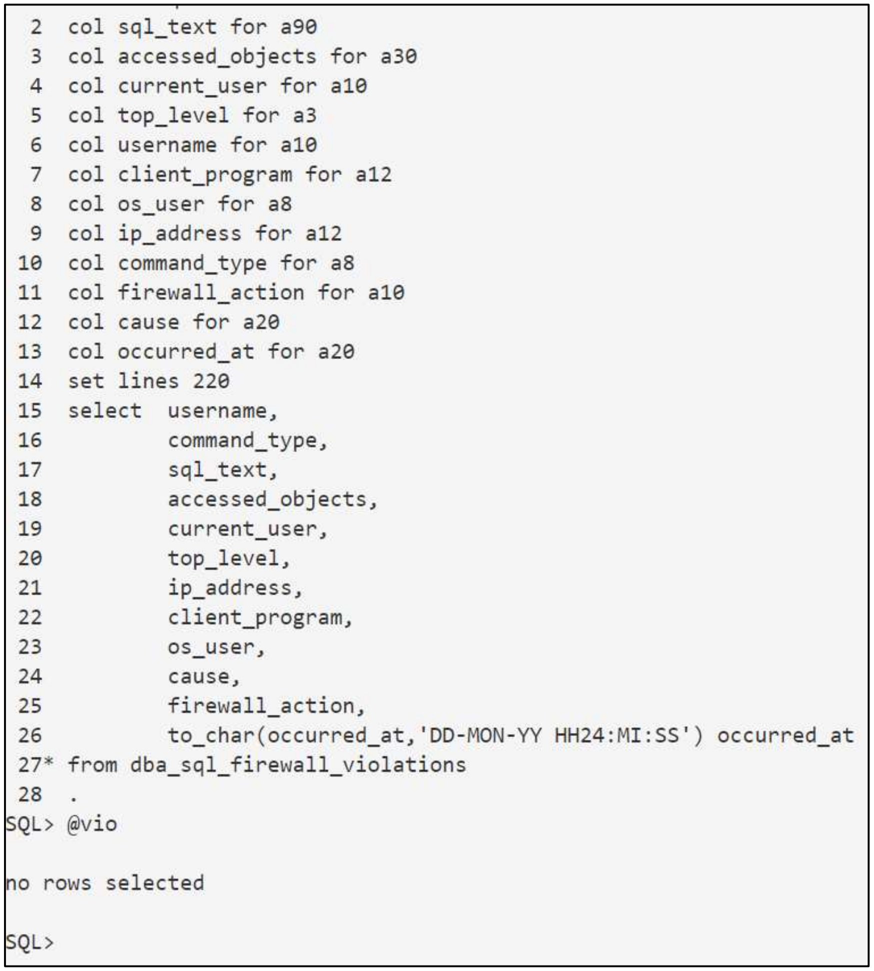
Section

Testing

- sf_vio.sql

Check for Violations

- Check for none



```
col sql_text for a90
col accessed_objects for a30
col current_user for a10
col top_level for a3
col username for a10
col client_program for a12
col os_user for a8
col ip_address for a12
col command_type for a8
col firewall_action for a10
col cause for a20
col occurred_at for a20
set lines 220
select  username,
        command_type,
        sql_text,
        accessed_objects,
        current_user,
        top_level,
        ip_address,
        client_program,
        os_user,
        cause,
        firewall_action,
        to_char(occurred_at,'DD-MON-YY HH24:MI:SS') occurred_at
from dba_sql_firewall_violations
.
SQL> @vio

no rows selected

SQL>
```

- sf_run_vm.sql

Testing

- Run normal business actions
- Test the application works
- Test that no SQL Firewall violations are found
- Adjust the rules, contexts if necessary

Section

Hacking

- sf_run.sql
- sf_vio.sql

Try and Abuse the Database

- Try an INSERT statement that is not allowed by the SQL Firewall
- Try an UPDATE not allowed by database permissions
- Try a SELECT not allowed by permissions
- The INSERT is blocked by the firewall but the other two return database errors as normal

- sf_hack.sql
- sf_hack1.sql
- sf_vio.sql

Hack The Database

- Test some SQL injection to access tables and views not allowed by the firewall but allowed for ORABLOG and not VM
- Show direct access to the same tables / views as VM directly
- The SQL Injection is not blocked
- The direct view access is
- To block SQL Injection we need to relearn with not TOP LEVEL ONLY

- sf_syn.sql
- sf_view.sql
- sf_desc.sql
- sf_vio.sql

More Testing

- Test access to the same data as VM via a synonym
- Test access to the same data via a view
- Test creation of a view
- Test describe of a table allowed by the firewall

Section

Additions

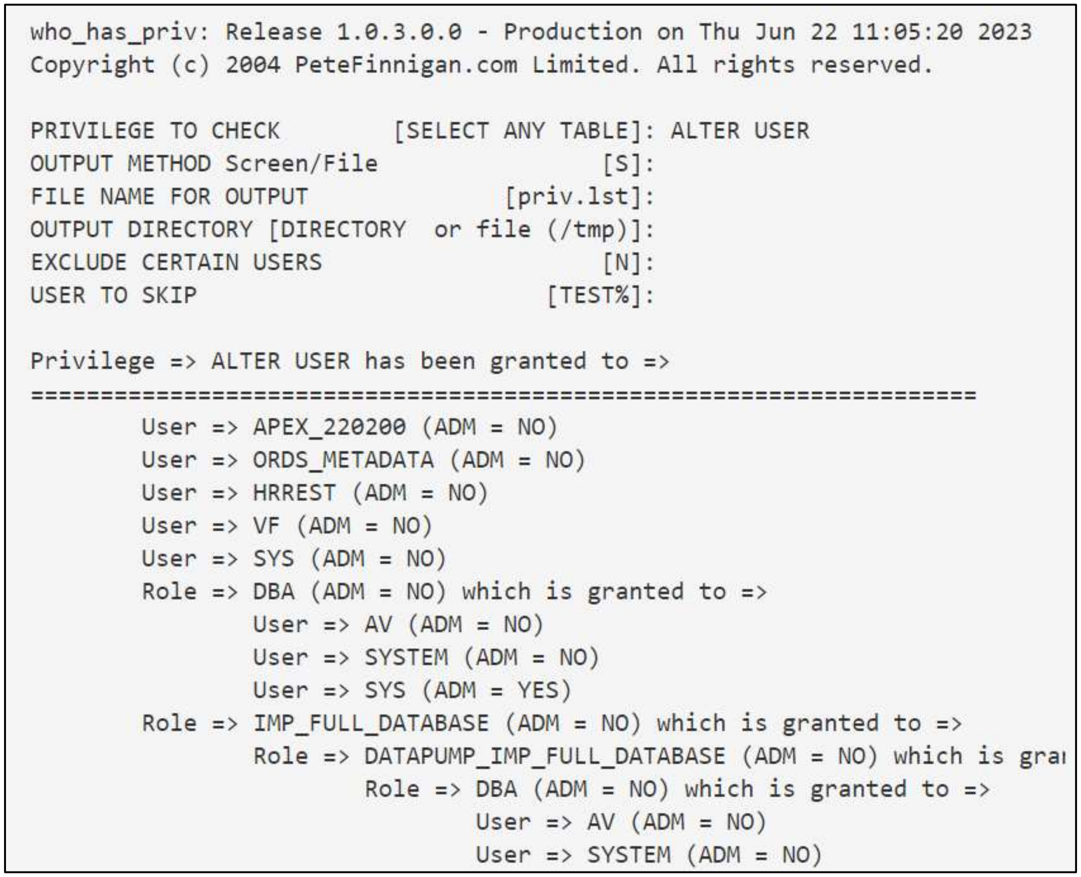
- sf_proxy.sql

Proxy

- I have long advocated the use of proxy to access a schema for maintenance
- The database knows who you are BUT you can be the schema/user in all other respects
- Proxy works with the SQL Firewall
- We create a connect user and grant access through VM

Proxy Issue

- If we have access to ALTER USER we can bypass the SQL Firewall
- So any users with IMP_FULL_DATABASE or APEX_220200 can access data or function protected by SQL Firewall by allowing …GRANT CONNECT THROUGH…



```
who_has_priv: Release 1.0.3.0.0 - Production on Thu Jun 22 11:05:20 2023
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PRIVILEGE TO CHECK        [SELECT ANY TABLE]: ALTER USER
OUTPUT METHOD Screen/File                [S]:
FILE NAME FOR OUTPUT              [priv.lst]:
OUTPUT DIRECTORY [DIRECTORY  or file (/tmp)]:
EXCLUDE CERTAIN USERS                    [N]:
USER TO SKIP                         [TEST%]:

Privilege => ALTER USER has been granted to =>
====================================================================
        User => APEX_220200 (ADM = NO)
        User => ORDS_METADATA (ADM = NO)
        User => HRREST (ADM = NO)
        User => VF (ADM = NO)
        User => SYS (ADM = NO)
        Role => DBA (ADM = NO) which is granted to =>
                User => AV (ADM = NO)
                User => SYSTEM (ADM = NO)
                User => SYS (ADM = YES)
        Role => IMP_FULL_DATABASE (ADM = NO) which is granted to =>
                Role => DATAPUMP_IMP_FULL_DATABASE (ADM = NO) which is gra
                        Role => DBA (ADM = NO) which is granted to =>
                                User => AV (ADM = NO)
                                User => SYSTEM (ADM = NO)
```

Section

SQL Firewall Management

Manage the SQL Firewall

- Rules / settings can be changed after learning / creation
  - Rules removed, New rules, Add more context – or remove
  - Add more users
- Clear the logs
- Connect to unified audit
  - two new columns FW_ACTION_NAME and FW_RETURN_CODE
  - New COMPONENT clause “SQL Firewall”
  - No direct link between UNIFIED_AUDIT_TRAIL and SQL Firewall views
- Deep level needed to catch SQL injection

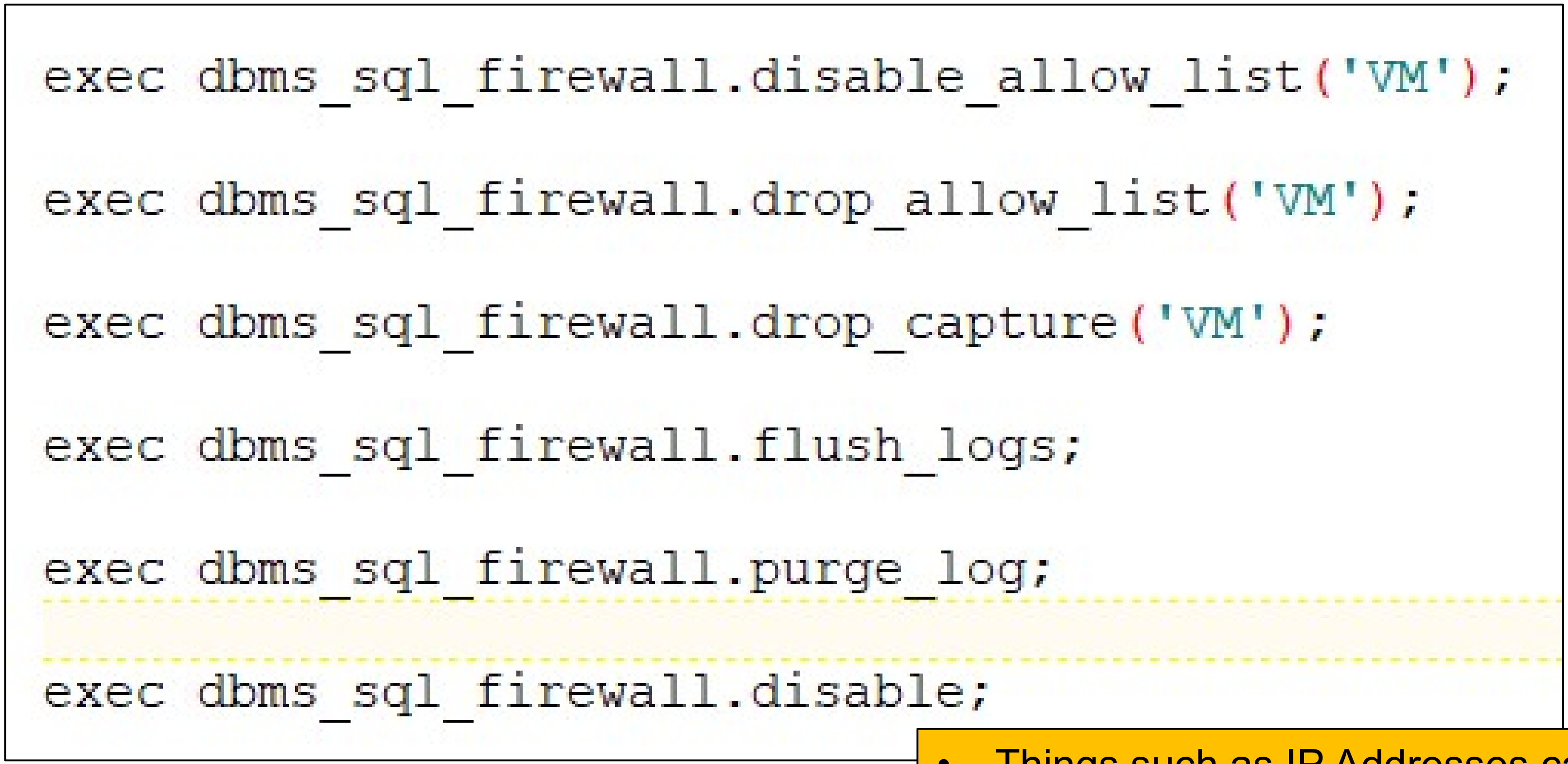
- sf_status.sql

Checking the SQL Firewall Status

- We can query all of the SQL Firewall views to check the status of the firewall, captures, allows and logs

SQL Firewall Management

- sf_dis.sql
- sf_drop_users.sql



```
exec dbms_sql_firewall.disable_allow_list('VM');

exec dbms_sql_firewall.drop_allow_list('VM');

exec dbms_sql_firewall.drop_capture('VM');

exec dbms_sql_firewall.flush_logs;

exec dbms_sql_firewall.purge_log;

exec dbms_sql_firewall.disable;
```

- Things such as IP Addresses cannot be removed if the firewall is disabled
- Disabling the firewall doesn’t remove anything

Conclusions

- Complex
- Doesn’t look like its free for lower versions
- Its very specific to users, context and SQL
- Do not train hacking
- Do not use instead of data security
- All actions must be learned – i.e. known in advance
- Will need a lot of maintenance
- Allow / **disallow**

Questions

?

If Anyone has questions, please ask now or catch me during the event!!

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