

Oracle Database Vault in Real Life

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Oracle Database Vault in Real Life

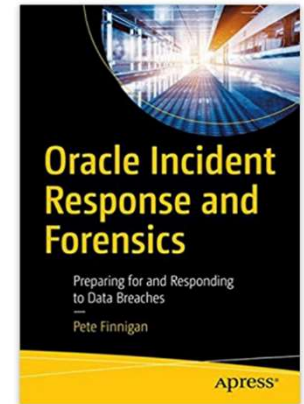
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Pete Finnigan – Background, Who Am I?

- 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

- Securing Oracle
- Three elements to secure
- Do you want to go further?
- Do it the hard way
- Use Database Vault to add better security
- Report and verify

Section

Securing Oracle

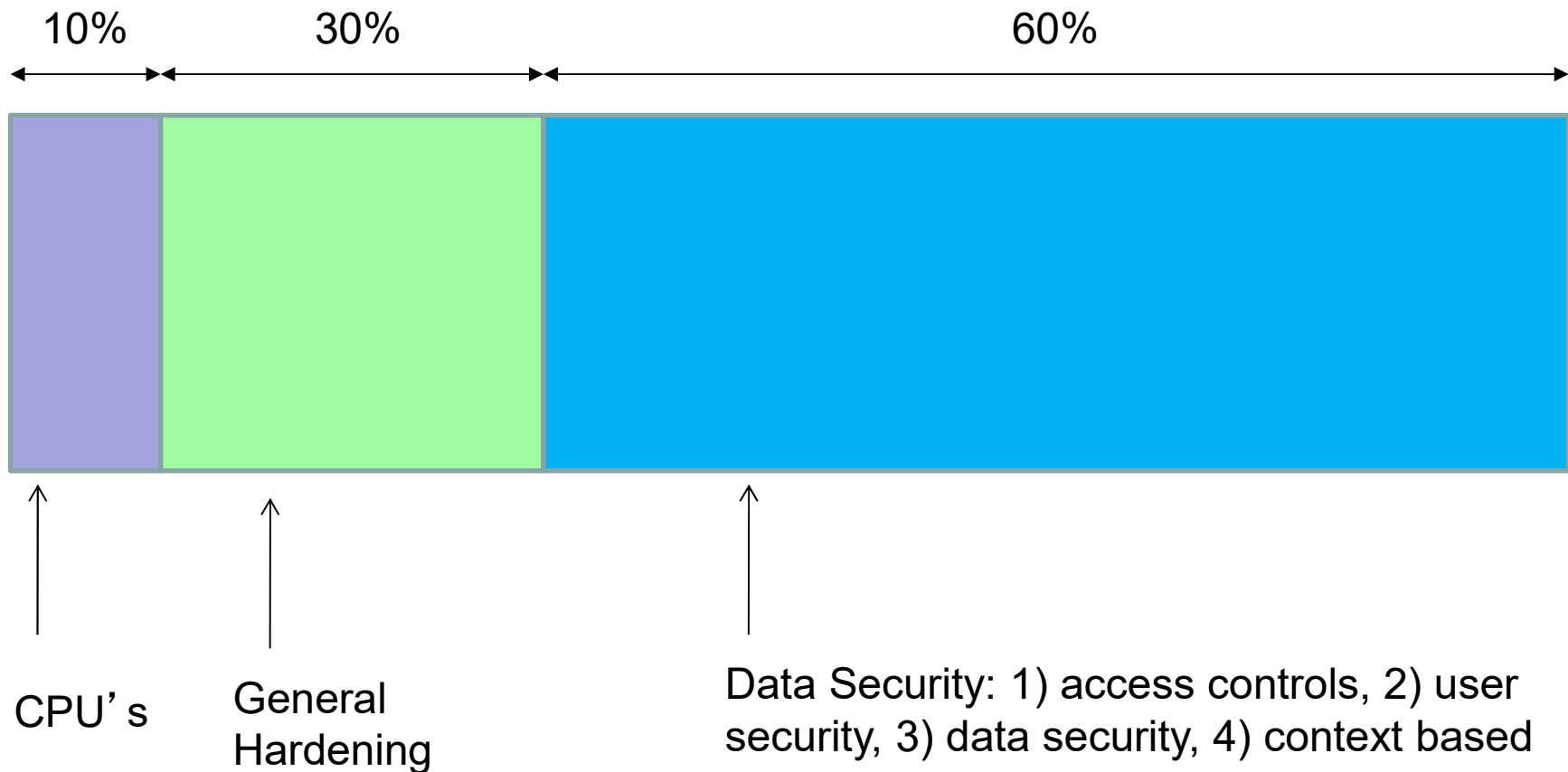
Secure Data

- The focus for us is to secure data and not “Oracle Security”
- We must use features of Oracle to secure our data BUT simply following a check list
- Securing to a list does not work as we must secure based on OUR data and OUR use of that data
- **We will keep this talk fairly high level**

Section

Three Elements to Secure

Compartmentalise Data Security?



Splitting Up Data Security in Oracle

- (1) - 10% - Patching
- (2) - 30% - Hardening
- (3) - 60% - Data Security design
 - Data design
 - (1) - Access controls
 - (2) - User security
 - (3) - Data access controls
 - Audit trails
 - Secure coding
 - Context based security
 - Either products from Oracle such as DV, OLS, VPD, TSDP,...
 - Home grown

Context Based Security

- Enhance other layers of security
- Allows detailed level security
 - Allow pete to access credit cards from JDE and only from the office and on a PC in the accounts department
- How?
 - Limit the database user, limit the application, limit the location, Limit by machine domain, limit by application roles of context / info / etc,

Section

Do you Want to go Further?

We Want to Achieve Better Security

- We must use context
 - That context must be secure and trusted
- Can do some things with VPD, ...
- Can do by hand with
 - PL/SQL code, triggers, secure application roles, views and more
- Why is this an issue to do by hand?
 - Lots of code, Design the framework yourself
 - Can be bypassed as Oracle is complex



Section

Do it the Hard Way

Context: View Based Security

- We can create VIEW BASED security to limit access to read data
 - A PL/SQL function allows tests to be made to check whether access is allowed or not
 - We could also check in this PL/SQL whether the privilege used is SELECT ANY by checking the users actual rights
 - This can block some ANY privileges
 - **BUT system ANY for select can access the base table.**
- Solution:**
- Revoke system ANY except for sys
 - Block SYSDBA access – The first versions of DV did this

Context: DML Based Security

- We can apply the same “Realm” type ideas to block DML with triggers
- This cannot be overridden as this is added to the base table and this is not view based
- Again we could check for System ANY in the PL/SQL code by looking at the callers rights
- We can also make a mandatory realm – in part at least with context based code



Command Rule: Block SQL*Plus - Webserver

```
133     program,  
134     os_user  
135 ) values (lv_username,lv_ip_address,lv_program,lv_os_user);  
136 commit;  
137  
138 if(lv_ip_address not in('192.168.56.91','192.168.56.89','192.168.56.1','192.168.56.85','192.168.56.90')) then  
139     -- the IP address is not allowed  
140  
141     insert into stk_login_error (login_date,error_line) values (sysdate,1);  
142     commit;  
143     RAISE_APPLICATION_ERROR(-20070,'NOT AUTHORISED FROM THIS HOST');  
144  
145 else  
146     -- test for web server and not apache and not httpd  
147     if( (lv_ip_address in('192.168.56.89')) and  
148         (upper(lv_program)<>'HTTPD@OEL59ORABLOG.LOCALDOMAIN (TNS V1-V3)') and  
149         (upper(lv_os_user)<>'APACHE')) then  
150  
151         -- web server and not httpd and not apache OS user  
152         insert into stk_login_error (login_date,error_line) values (sysdate,2);  
153         commit;  
154         RAISE_APPLICATION_ERROR(-20071,'NOT AUTHORISED WITH THESE DETAILS');  
155     else  
156         -- we must be on the admin PC or the actual database server  
157         insert into stk_login_error (login_date,error_line) values (sysdate,3);  
158         commit;  
159     end if;  
160 end if;  
161 -- record that we got here  
162 insert into stk_login_error (login_date,error_line) values (sysdate,4);  
163 commit;  
164 exception  
165 when others then  
166     insert into stk_login_error (login_date,error_line) values (sysdate,5);  
167     commit;  
168     RAISE_APPLICATION_ERROR(-20073,sqlerrm);  
169 --  
170 end login_dba;  
171 /
```

- We can perfectly replicate the protection we have in DV with a logon trigger
- We can also use valid node checking but this is not granular
- In this example the httpd still works but SQL*Plus from the webserver is blocked

Section

Use Database Vault to Add Better Security

What Is Database Vault?

- Declarative security framework to allow fine grained access to database objects (tables, views, procedures...) grouped into realms
- Literally unlimited context based security rules can be added to control access to any (well almost any) database object or command
- Default use is to protect against **SYSTEM ANY** privileges
- Because it is “built-in” to the database kernel it is harder to bypass
- Pre-built shipped settings protect risky parameter changes and the data dictionary and more
- Separation of duties are added by default by creation of a security administrator, user account manager and vault owner
- SYS, SYSTEM and DBA are restricted in value
- Most components / features have protections that can be used

The Main DV Components

- Factors
 - Individual elements to use in rules (e.g. IP Address)
- Rules
 - True/False questions for the database
- Rule Sets
 - Groups of rules (Also results in True/False – with AND/OR)
- Realms
 - Protect database objects (**uses rules, factors**)
- Command Rules
 - Protect access to SQL commands (e.g. CONNECT) (**uses rules, factors**)
- Secure Application Roles (SAR)
 - Protective access to enable a role (**uses rules, factors**)

Hacking The Sample Database Before DV

Oracle Security Services

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```
x%'))))a)**/union/**/select/**/33,1,to_timest
amp('27-OCT-13'),to_timestamp('27-OCT-
13'),'CardNumber-||first_name||'-
'last_name||'-
'||orablog_crypto.decrypt(pan),'x',0,null,'publi
sh','open','open',null,'name',null,null,to_time
stamp('27-OCT-13'),to_timestamp('27-OCT-
13'),null,0,null,0,null,null,0,6/**/from/**/orabl
og.credit_card--
```

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As an un-athenticated web user

Hacking The Sample Database After DV OOTB

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Same Hack as previous with no DV, same result

DV Add A Realm – Hack Again

```
SQL> -- create a simple realm for BOF
SQL> connect dvo/dvo@//192.168.56.94:1521/dvtst.localdomain
Connected.
SQL>
SQL> -- remove the realm to re-create
SQL> exec dbms_macadm.delete_realm('BOF Realm');

PL/SQL procedure successfully completed.

SQL>
SQL> -- create the BOF realm
SQL> begin
  2      dbms_macadm.create_realm(
  3          realm_name => 'BOF Realm',
  4          description => 'Protect BOF objects',
  5          enabled => dbms_macutl.g_yes,
  6          audit_options => dbms_macutl.g_realm_audit_fail,
  7          realm_type => 0);
  8 end;
  9 /

PL/SQL procedure successfully completed.

SQL>
SQL> -- add the objects to the realm
SQL> begin
  2      dbms_macadm.add_object_to_realm(
  3          realm_name => 'BOF Realm',
  4          object_owner => 'ORABLOG',
  5          object_type => '%',
  6          object_name => '%');
  7 end;
  8 /

PL/SQL procedure successfully completed.
```

- Create a realm to effectively add the ORABLOG schema objects to that realm and so that System ANY is not able to be used on ORABLOG objects by any other user.
- Do the same hacks as before still work?
- The applications (Orablog and BOF) still work correctly even with the realm in place

Hacking The Sample Database With Realm

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```
x%'))))a)**/union/**/select/**/33,1,to_timest
amp('27-OCT-13'),to_timestamp('27-OCT-
13'),'CardNumber-||first_name||'-
'last_name||'-
'||orablog_crypto.decrypt(pan),'x',0,null,'publi
sh','open','open',null,'name',null,null,to_time
stamp('27-OCT-13'),to_timestamp('27-OCT-
13'),null,0,null,0,null,null,0,6/**/from/**/orabl
og.credit_card--
```

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Same Hack as previous tests, same result!!

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Hmmm, the aps are now broken; we need to add ORABLOG to the realm but it defeats the object

Add Mandatory Realm – Hack Again

```
SQL> exec dbms_macadm.delete_realm('BOF Realm');
```

PL/SQL procedure successfully completed.

```
SQL>
SQL> -- create the BOF realm
SQL> begin
  2     dbms_macadm.create_realm(
  3         realm_name => 'BOF Realm',
  4         description => 'Protect BOF objects',
  5         enabled => dbms_macutl.g_yes,
  6         audit_options => dbms_macutl.g_realm_audit_fail,
  7         realm_type => 1);
  8 end;
  9 /
```

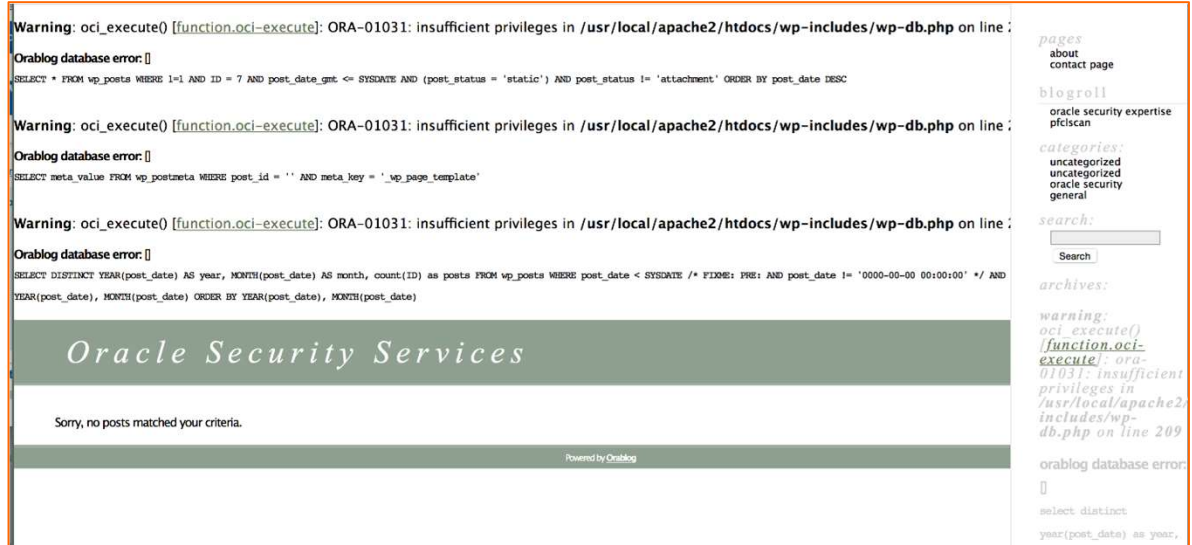
PL/SQL procedure successfully completed.

```
SQL>
SQL> -- add the objects to the realm
SQL> begin
  2     dbms_macadm.add_object_to_realm(
  3         realm_name => 'BOF Realm',
  4         object_owner => 'ORABLOG',
  5         object_type => '%',
  6         object_name => '%');
  7 end;
  8 /
```

PL/SQL procedure successfully completed.

```
SQL> select name, realm_type from dvsys.dba_dv_realm;
```

```
NAME
-----
Oracle Database Vault
Database Vault Account Management
Oracle Enterprise Manager
Oracle Default Schema Protection Realm
Oracle System Privilege and Role Management Realm
Oracle Default Component Protection Realm
BOF Realm
```



```
Warning: ociexecute() [function.ociexecute]: ORA-01031: insufficient privileges in /usr/local/apache2/htdocs/bof_address.php on line 78
Warning: ocifetchstatement() [function.ocifetchstatement]: ORA-24374: define not done before fetch or execute and fetch in /usr/local/apache2/htdocs/bof_address.php on line 80
```

BOF: Back Office Customer Management - PeteFinnigan.com Limited

MANDATORY

Add Mandatory Realm – Fix The Realm Auth

```
SQL> -- remove the realm to re-create
SQL> exec dbms_macadm.delete_realm('BOF Realm');
```

PL/SQL procedure successfully completed.

```
SQL>
SQL> -- create the BOF realm
SQL> begin
2     dbms_macadm.create_realm(
3         realm_name => 'BOF Realm',
4         description => 'Protect BOF objects',
5         enabled => dbms_macutl.g_yes,
6         audit_options => dbms_macutl.g_realm_audit_fail,
7         realm_type => 1);
8 end;
9 /
```

PL/SQL procedure successfully completed.

```
SQL>
SQL> -- add the objects to the realm
SQL> begin
2     dbms_macadm.add_object_to_realm(
3         realm_name => 'BOF Realm',
4         object_owner => 'ORABLOG',
5         object_type => '%',
6         object_name => '%');
7 end;
8 /
```

PL/SQL procedure successfully completed.

```
SQL>
SQL> -- add ORABLOG to the realm as a participant
SQL> begin
2     dbms_macadm.add_auth_to_realm(
3         realm_name => 'BOF Realm',
4         grantee => 'ORABLOG',
5         rule_set_name => NULL,
6         auth_options => dbms_macutl.g_realm_auth_participant);
7 end;
8 /
```

PL/SQL procedure successfully completed.

BOF: Back Office Customer Management - PeteFinnigan.com Limited

- Address
- Customers
- Employees
- Offices
- Orders
- Order Details
- Payments
- Pay Details

Display Pay Details

number of records found is:2

[Add a New Pay Details here](#)

Id	Amount	Name On Card	Cc34	Start Date	End Date	Last Four	Edit
1	13-MAR-2012 - 2495	Mr David Bentley	4049877198543457	01-FEB-11	01-AUG-16	3457	Edit

Oracle Security Services

March 4, 2008

About

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This is PeteFinnigan.com Limiteds test website. This is not our live website of course but one we have created to demonstrate various things during our training classes and other tasks that need demonstrations.

It is a simple website that uses an older version of Wordpress – version 2.0.4; but it uses Oracle for the database and not MySQL as normal. The software is orablog version 0.3 – available on Sourceforge. It appears to have been created in 2006.

This version of Wordpress was originally on the orablog.net website but that support site is no longer there...-!-. The code was downloaded by us in 2008 and it didn't work. The code

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```
x%'))))a)/**/union/**/select/**/33,1,to_timest
amp('27-OCT-13'),to_timestamp('27-OCT-
13'),'CardNumber-||first_name||'-
'last_name||'-
'||orablog_crypto.decrypt(pan),'x',0,null,'publi
sh','open','open',null,'name',null,null,to_time
stamp('27-OCT-13'),to_timestamp('27-OCT-
13'),null,0,null,0,null,null,0,6/**/from/**/orabl
og.credit_card--
```

Comments (0)

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Same Hack as previous tests, same result!!



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DV Command Rule – Create the Rules

```
21 -- create the factor
22 begin
23   dbms_macadm.create_factor(
24     factor_name => 'PFCLProgramName',
25     factor_type_name => 'Application',
26     description => 'Locate the program name from the session',
27     rule_set_name => NULL,
28     validate_expr => NULL,
29     get_expr => 'UPPER(SYS_CONTEXT(''USERENV'', ''MODULE''))',
30     identify_by => DBMS_MACUTL.G IDENTIFY_BY_METHOD,
31     labeled_by => DBMS_MACUTL.G LABELED_BY_SELF,
32     eval_options => DBMS_MACUTL.G EVAL_ON_SESSION,
33     audit_options => DBMS_MACUTL.G AUDIT_ON_GET_ERROR,
34     fail_options => DBMS_MACUTL.G FAIL_SILENTLY);
35 end;
36 /
37 -- create the rule set
38 begin
39   dbms_macadm.create_rule_set(
40     rule_set_name => 'Enforce ORABLOG Webserver',
41     description => 'Ensure that ORABLOG can only connect with Apache from the webserver',
42     enabled => DBMS_MACUTL.G YES,
43     eval_options => DBMS_MACUTL.G RULESET_EVAL_ANY,
44     audit_options => DBMS_MACUTL.G RULESET_AUDIT_OFF,
45     fail_options => DBMS_MACUTL.G RULESET_FAIL_SHOW,
46     fail_message => 'SQL*Plus not allowed for ORABLOG from the Webserver',
47     fail_code => 20403,
48     handler_options => DBMS_MACUTL.G RULESET_HANDLER_OFF,
49     handler => NULL,
50     is_static => FALSE);
51 end;
52 /
53 -- create the rules
54 begin
55   dbms_macadm.create_rule(
56     rule_name => 'Prevent ORABLOG Use of SQL*Plus From WebServer',
57     rule_expr => '((UPPER (DVF.F$PFCLPROGRAMNAME) = ''HTTPD@OEL59ORABLOG12 (TNS V1-V3)'') AND UPPER (DVF.F$CLIENT_IP) in(
58     . ''192.168.56.97'')) OR (UPPER (DVF.F$CLIENT_IP) in( ''192.168.56.1'', ''192.168.56.90''|)) AND DVF.F$SESSION_USER IN
59     . (''ORABLOG'')));
60 end;
```



DV Command Rule – Code Continued

```
59 begin
60     dbms_macadm.create_rule(
61         rule_name => 'Allow All Other Users Access',
62         rule_expr => 'DVF.F$SESSION_USER NOT IN (''ORABLOG'')');
63 end;
64 /
65 -- add the rules to the rule set
66 begin
67     dbms_macadm.add_rule_to_rule_set(
68         rule_set_name => 'Enforce ORABLOG Webserver',
69         rule_name => 'Prevent ORABLOG Use of SQL*Plus From WebServer',
70         rule_order => 1);
71 end;
72 /
73 begin
74     dbms_macadm.add_rule_to_rule_set(
75         rule_set_name => 'Enforce ORABLOG Webserver',
76         rule_name => 'Allow All Other Users Access',
77         rule_order => 1);
78 end;
79 /
80
81 -- create the connect command rule
82 begin
83     dbms_macadm.create_command_rule(
84         command => 'CONNECT',
85         rule_set_name => 'Enforce ORABLOG Webserver',
86         object_owner => '%',
87         object_name => '%',
88         enabled => DBMS_MACUTL.G_YES);
89 end;
90 /
```

DV Command Rule - Results

```
SQL> connect orablog/orablog@//192.168.56.94:1521/dvtst.localdomain  
ERROR:  
ORA-47306: 20403: SQL*Plus not allowed for ORABLOG from the Webserver
```

```
SQL> !hostname  
oe159orablog12
```

```
SQL> connect orablog/orablog@//192.168.56.94:1521/dvtst.localdomain  
Connected.  
SQL> !hostname  
Peters-MBP
```

- The rules are not perfect as we have implemented properly only for Orablog and not BOF but BOF has no client tools installed
- The client_program_name is not set from the server so we have used instead Module – but it would be better to use the hash
- Implementing factors, rules, rule sets and command rules or rule sets for realms is a large task when a lot of controls are needed

Do Not Use DV

- Don't use Database Vault if you do not have normal database security
- Even then
 - Use standard database security first
 - Achieve some of DV with standard features – i.e. do not use DBA, SYS and SYSTEM, revokes, %ANY% remove,...
- Secure DV
- Then use DV to enhance existing data security

TDE Would Benefit from Database Vault

- TDE can be used to protect data at rest
- In a typical database data in datafiles is visible on the OS to “oracle” Unix user only
- If TDE is used then it protects the datafiles at rest on tape or other media
- The “oracle” user can connect “/ as sysdba” and see any TDE protected data
- Database Vault can be used to protect the access to the TDE data when connected

Choose the Correct DV Solution

- Keep the Database Vault set up as simple as possible
- Use simple rules / rule sets that can be verified
- Use designs not random code
- Use the right solution; command rule, SAR, Realm based on the requirement
- Enrich realms with command rules

Do Not Mix

- If an object must appear in multiple realms
 - use one realm and more complex rules
 - Or multiple realms and simpler rules
 - Don't cross over in rules
- Layer command rules on realms if necessary
- Design and create simple rules and rule sets
- Design necessary factors and ensure they are secure



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Section

Report and Verify

Check The DV Security

- Run `sc_dv.sql`
- >20k lines O/P
- Check rules

```
-----  
Oracle Database Vault Configuration Report  
-----  
  
PL/SQL procedure successfully completed.  
  
DBID           : 1405253007  
Name           : FREE  
Container Name: FREEPDB1  
  
PL/SQL procedure successfully completed.  
  
Oracle Database Vault is Not Enabled  
  
PL/SQL procedure successfully completed.  
  
~~~~~  
Database Vault Status  
~~~~~  
  
PL/SQL procedure successfully completed.  
  
DV_CONFIGURE_STATUS  FALSE  
DV_ENABLE_STATUS     FALSE  
DV_APP_PROTECTION    NOT CONFIGURED
```

Conclusions

- Database Vault is complex
- Its use **MUST** be on top of hardened database with designed data security
- Do not mix
- Secure DV
- Use DV to enhance data security not replace standard security

Questions

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

Oracle Database Vault in Real Life
