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## Oracle Forensics

By  
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## Introduction - Commercial Slide. ☹

- PeteFinnigan.com Limited
- Founded February 2003
- CEO Pete Finnigan
- Clients UK, States, Europe
- Specialists in researching and securing Oracle databases
- <http://www.petefinnigan.com>
- Consultancy and training available
- Author of Oracle security step-by-step
- Published many papers, regular speaker (UK, USA)



## Agenda

- What is forensics and Oracle forensics?
- In real terms what does it mean?
- What information is out there
- Are there any tools?
- The issues – audit on, audit off and more
- Where to find forensic data
- Finding evidence – correlating data
- Plan for forensic analysis – make it easy

## What is Forensics?

### fo-ren-sics

*n. (used with a sing. verb)*

1. The art or study of formal debate; argumentation.
2. The use of science and technology to investigate and establish facts in criminal or civil courts of law.

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## What is Oracle Forensics?

- Oracle forensics is the process by which someone (an auditor?) tries to determine when / how / why (and by who) something happened by gathering correlated and incriminating evidence.
- Oracle forensics often occurs when as an auditor I am called in to help a client discover how a breach occurred and hopefully some clue as to who did it.
- These techniques are often championed through the need to do this with no audit trail, no archive logs or worse – the success rates are dependant on how fast we can look and what is available.
- If this leads to criminal proceedings the evidence must be gathered without distortion or change to the system.

## What Information Is Out There?

- 2 books – (note: neither book is available as I write this):
  - (2007) - Oracle Forensics: Paul Wright – ISBN-10-0977671526
  - (2008) - Oracle Forensics Analysis Using the Forensic Examiners Database Scalpel (FEDS) Tool - ISBN-10: 047019118X My papers
- Pete Finnigan (2003) - Detecting SQL Injection in Oracle - <http://www.securityfocus.com/infocus/1714> some forensics ideas - mining redo, sql extraction, trace, audit
- David Litchfield (2007) – 6 part paper - <http://www.databassecurity.com/>
- Pete Finnigan (2004) – Oracle Forensics module – SANS training

## What Information Is Out There? (2)

- Arup nanda (2005) – Mining for clues - <http://www.oracle.com/technology/oramag/oracle/05-jul/o45dba.html>
- Alejandro Vargas (2007) – Log Miner 10g Implementation Example - <http://static7.userland.com/oracle/gems/alejandroVargas/logminerexample.pdf>
- Paul Wright (2006/7) – Number of papers – <http://www.oracleforensics.com> + his SANS GSOC paper [http://www.sans.org/reading\\_room/whitepapers/application/](http://www.sans.org/reading_room/whitepapers/application/)
- Alex Gorbachev (2006) – Log Miner for forensics - <http://www.pythian.com/blogs/269/oracle-logminer-helps-investigate-security-issues>
- David Litchfield (2007) – Blackhat paper - <http://www.databasesecurity.com/dbsec/forensics.ppt>

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## Are There Any Tools?

- Yes and no
- There are no specific Oracle forensics tools – Yet.
  - David is developing FEDS
- Most of the evidence can be extracted with existing tools
  - Simple SQL Queries
  - Database dumps
  - More exotic options, BBED, ORA-Dude, AUL/MyDUL
  - Connect to the SGA to read the SQL in the SGA

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## The Issues

- The problem when you want to investigate why is that inevitably there is no audit trail
- If audit is on, then use it. Beware of testing for altered audit trails
- If no audit and archive log is on use the changes captured
- If no audit, no archive logs then there is still hope
- Mining blocks and redo is time and error prone
- Detecting "Select" statements is harder

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## Where To Find Forensic Data

- TNS listener log
- Many types of trace files
- Sqlnet logs (server and clients)
- Sysdba audit logs
- Datafiles for deleted data
- Redo (and archive) logs
- SGA (v\$sql etc)
- Apache access logs

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## Where To Find Forensic Data (2)

- v\$db\_object\_cache
- Wrh\$%% views
- Wri\$ views
- Statspack views
- col\_usage\$
- Audit trails –
  - AUD\$, FGA\_LOG\$
  - Application audit (who/when, triggers, other)
- Flashback, recycle bin
- More?

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## Looking For A Password Change

```

SQL> select user,password from v$sql where text like 'update user@password('';

```

The disadvantage of the SGA is that a database restart flushes it, a shared pool flush will also remove evidence and also the data is very transient. For a password change everything ran as SYS so other correlations are necessary to find the actual user who did it. Views such as v\$sql\_bind\_data and v\$sql\_bind\_capture can sometimes reveal data

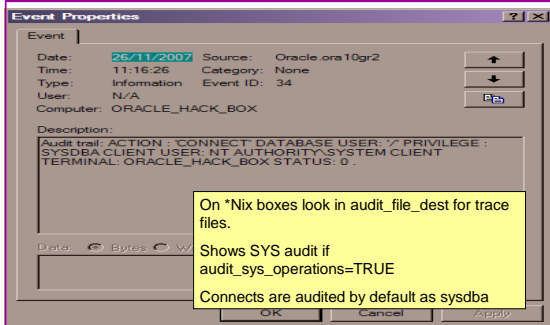
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## Tertiary Data – SYSDBA Audit



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## Deleted Data

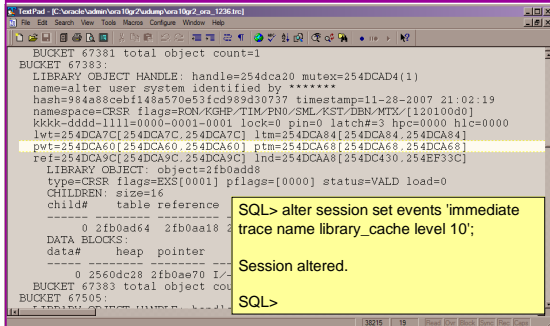
- David introduced the idea of looking for deleted data in data blocks in his 6 part Oracle forensics series.
- This is not new as others more concerned with recovery, block internals, DUL like tools have found this years ago.
- The idea is being built into FEDS
- Beware:
  - This is unsupported – in terms of undefined results
  - The deleted data is transient
- Recycle bin and Flashback also good options (If available)
- As is Redo and archive logs (not transient) – again if available

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## Database Dumps



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## Investigation Without Disturbance

- If a suspected breach has occurred
- Plan ahead
- Consider:
  - Can the results of the investigation be trusted
  - Altering the database or shutting down could remove evidence – e.g. shared pool is cleared
  - The investigation should not alter the data or create a large foot print in the database thereby changing the value of the investigation

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## Investigation Without Disturbance (2)

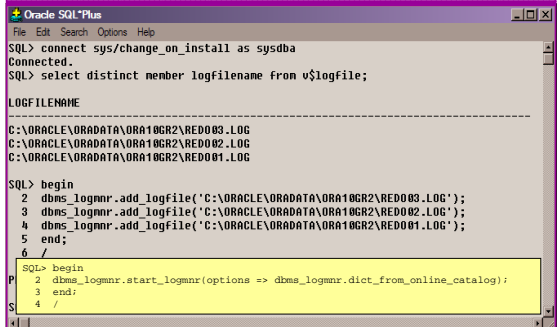
- Establish the server state – users, ports, files, dll's, memory, system time etc
- Collect Oracle files – sysdba trace, archive logs, alert log, listener log, sqlnet logs, trace, copy data files (if possible)
- Grab the SQL from v\$sql (direct SGA access is an option - <http://www.petefinnigan.com/other.htm>)
- Grab sys.aud\$
- Grab AWR and statspack if available
- Analyse changes to users and roles and privileges
- Checksum the PL/SQL, Java, triggers, views
- Investigate

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## Log Miner



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## Log Miner 2

```
Oracle SQL*Plus
File Edit Search Options Help

SQL> edit and
SQL> get and
1 select username,to_char(timestamp,'DD-MON-YYYY HH24:MI:SS') timestamp,
2 seg_name,operation,sql_undo
3 from v$logmnr_contents
4 where table_name='AUD$'
5 and sql_redo like 'AAAAAABAAABFKAAB%'
6 /

-----
USERNAME      TIMESTAMP
-----
SEG_NAME      OPERATION
-----
SQL_UNDO
-----
29-NOV-2007 21:29:38
SYS
update "SYS"."AUD$" set "ACTION" = '100', "RETURNCODE" = '0', "LOGOFF$READ" =
NULL, "LOGOFF$SPREAD" = NULL, "LOGOFF$SUMRITE" = NULL, "LOGOFF$DEAD" = NULL, "LOGO
FF$TIME" = NULL, "SESSIONPU" = NULL where "ACTION" = '101' and "RETURNCODE" =
'0' and "LOGOFF$READ" = '282' and "LOGOFF$SPREAD" = '0' and "LOGOFF$SUMRITE" = '0
' and "LOGOFF$DEAD" = '0' and "LOGOFF$TIME" = TO_DATE('29-NOV-07', 'DD-MON-RR')

-----
USERNAME      TIMESTAMP
-----
SEG_NAME      OPERATION
-----
SQL_UNDO
-----
and "SESSIONCPU" = '0' and ROWID = 'AAAAAABAAABFKAAB%';

SQL>
```

## Log Miner 3

```
Oracle SQL*Plus
File Edit Search Options Help

SQL> col username for a8
SQL> col timestamp for a20
SQL> col seg_type_name for a8
SQL> col seg_name for a10
SQL> col sql_redo for a30 wrap
SQL> edit
Wrote file afiedt.buf

1 select username,to_char(timestamp,'DD-MON-YYYY HH24:MI:SS') timestamp,
2 seg_type_name,seg_name,sql_redo
3 from v$logmnr_contents
4 where operation='DDL'
5* and sql_redo like 'alter user%'
SQL> /

-----
USERNAME      TIMESTAMP      SEG_TYPE      SEG_NAME      SQL_REDO
-----
SYSTEM      28-NOV-2007 21:02:20 USER      alter user system identified b
y UALUES 'D4DF7931AB130E37' ;

SQL>
```

## Build A Toolkit

- What can we build as toolkit?
- Mining blocks not ideal – time biased and not consistent – FEDS look promising BUT
- A Tool kit should / Could be methodology include:
  - A plan of actions
  - OS commands to gather files
  - SQL commands to gather details from the database
  - Dump commands

## Conclusions

- Looked at what are forensics and what are Oracle forensics?
- Looked at what information is out there
- Looked at the issues – audit on, audit off and more
- Looked at where to find forensic data
- Looked at finding evidence – correlating data
- Oracle Forensics is a new and exciting area and very current due to recent data losses

Any Questions?

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