PeteFinnigan.com Limited

Oracle Security Expertise

UKOUG Conference, December 5th 2007

Oracle Forensics

By

Pete Finnigan

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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.databasesecurity.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/
- 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

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

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

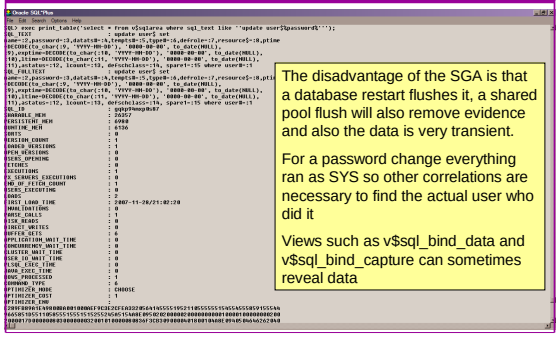
Where To Find Forensic Data

- 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

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?

Looking For A Password Change

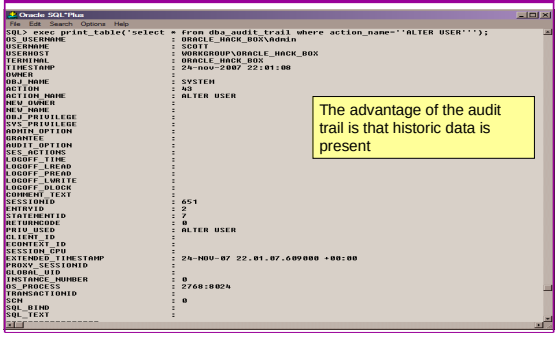


The disadvantage of the SGA is that a database restart flushes it, a shared pool flush will also remove evidence and also the data is very transient.

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

Data Gathering From AUD$

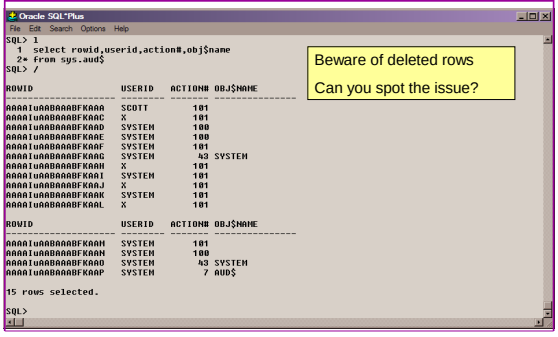


The advantage of the audit trail is that historic data is present

Audit trail Example

- If an audit trail exists then this can provide the best evidence
  - Check for SYS.AUD$ or core audit to OS
  - Check for SYS.FGA_LOG$
  - Check for Triggers and shadow tables
  - Test for who/when (E-Business Suite supports this)
- Don't depend on audit though as it may have been altered!
- Detect possible data changes first
  - Look for gaps
  - Correlate the audit trail (time, rowid, session, access and change to the audit trail itself – audit on audit)

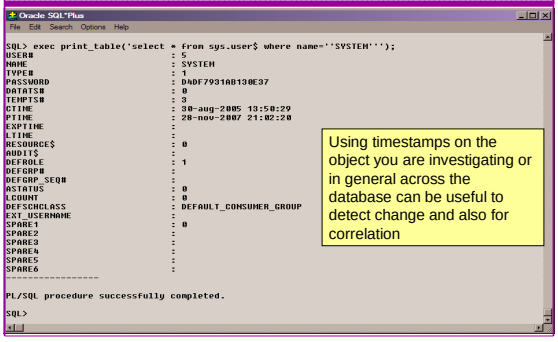
Audit Example 2



Beware of deleted rows

Can you spot the issue?

Timestamps

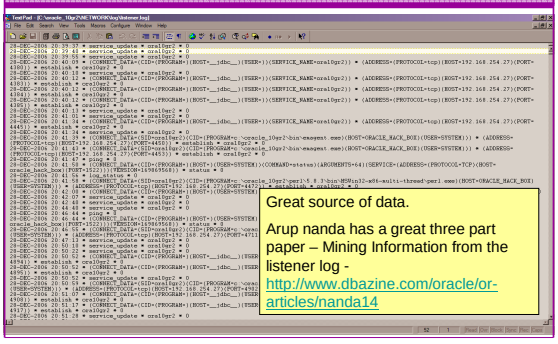


Using timestamps on the object you are investigating or in general across the database can be useful to detect change and also for correlation

Correlation

- Use correlation in two ways
  - If you have one piece of evidence look for others with matching values (could be time, address, sql_hash, scn, xid …)
  - If you don't know what to search for, i.e. you have been hacked but not sure how but know the time period; use the timestamp to locate all correlated evidence.
- Use timestamps on objects, redo (Log Mining) and more within the database
- Correlate time based evidence with external sources (oracle) such as listener.log, sql*net logs, sysdba trace
- Correlate user information with OS logs, client PC logs, firewalls, personal firewalls, web server logs

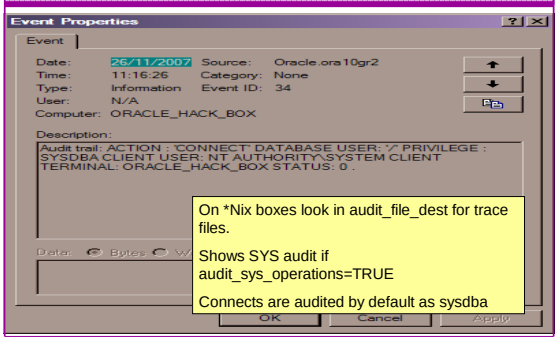
Tertiary Data – Listener.log



Great source of data.

Arup nanda has a great three part paper – Mining Information from the listener log - http://www.dbazine.com/oracle/or-articles/nanda14

Tertiary Data – SYSDBA Audit



On *Nix boxes look in audit_file_dest for trace files.

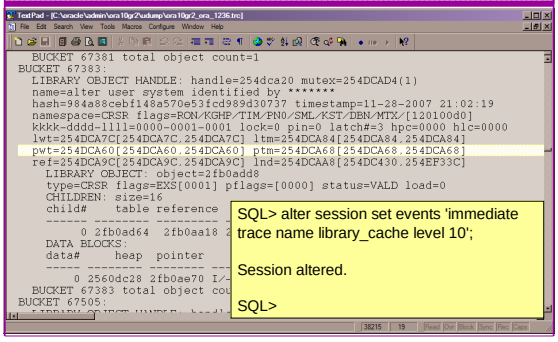
Shows SYS audit if audit_sys_operations=TRUE

Connects are audited by default as sysdba

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

Database Dumps



SQL> alter session set events 'immediate trace name library_cache level 10';

Session altered.

SQL>

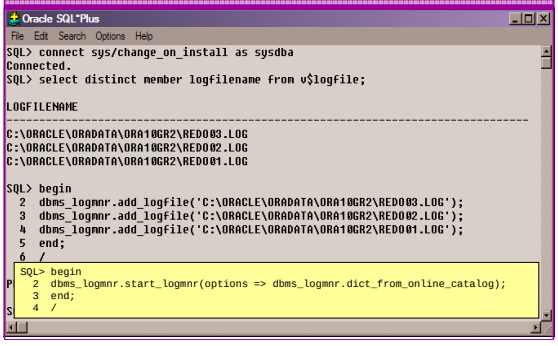
Investigation Without Disturbance

- 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

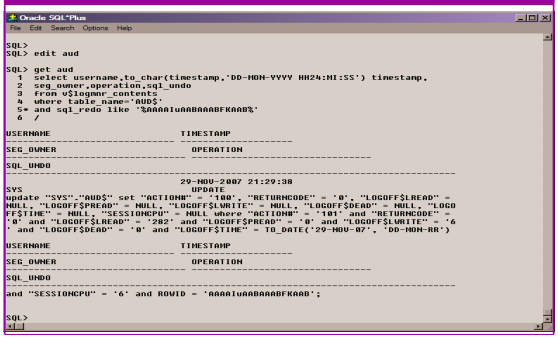
Investigation Without Disturbance (2)

- 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

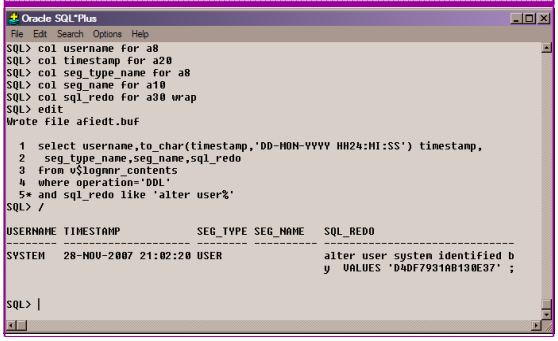
Log Miner



Log Miner 2



Log Miner 3



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

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Any Questions?

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