
# Create Onion Layers of Security

## Around Your Data

# Legal Notice

## Create Onion Layers of Security on Data Around Your Data

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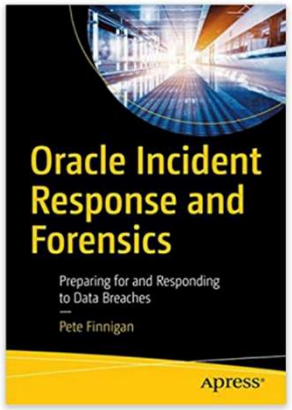


# Pete Finnigan – Background, Who Am I?

- 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

- A little history
- Secure data not databases
- Layers of data security
- Context based security
- Adaptive security
- Audit trails
- Work to a plan


# A Little History

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# Brief History Of Locking Down Oracle

- When I started to secure Oracle there were "**no**" or "**next to no**" books, papers, tools or security patches
- No one else was specializing in Oracle security in the database that I knew of
- Then in 2001 I was asked to write the SANS Oracle step-by-step guide
  - This also lead to the SANS S.C.O.R.E list
  - SANS donated the book to CIS for the first Oracle Security benchmark


# Database Security 22 Years Ago

- Companies were interested in data security BUT
  - No budget for data security
- Legacy thinking
  - Functionality
  - SLA
  - Not security of Oracle or data in Oracle
- Tendency to think that its someone else's issue; OS, Network, Firewalls etc; **just not the Oracle database**
- Companies had budgets only for desktop/network


# Oracle Security in 2022

- I see a reliance on traditional security ideas
  - Network security, firewalls, desktop, AD, anti-virus
  - I also see too big a focus on things like the CIS benchmark
    - This is focused on patch and harden
    - CIS is missing many things, 12c, 18c, 19c, 21c, CDB/PDB, ASM, newer…
    - It is a consensus but the consensus is too small
    - Its 10-15 years out of date
- **I see a push to tick boxes**
  - Buy TDE but don't otherwise secure the data in motion
  - Buy Database Vault but still have **one admin person** with root, Oracle, SYSDBA and DV realm owner, DV admin etc


# Oracle Security is Free and Cost Option

- Oracle added lots of database security products **but not free**
- BUT there are many free features that you can use to secure your data
- One problem; Even basics you have to do yourself:
  - Design permissions – it is not automatic
  - Identity is difficult from applications and not there by default
  - Shipped audit trails are simplistic since 10g and not adequate
  - Encryption is possible BUT you have to do key management…
- Most sites have open network routing still with no segmentation and no data security, no data firewalls, I even see databases in the DMZ


# Secure Data not Databases


# What Is Oracle Security?

- It is not Oracle's Security
- It is **our** security of **our** data


# We Must Target Data

- Logic of standards such as CIS for Oracle state that we must
  - Do basic hardening
  - Apply patches
  - Remove defaults
  - More…
- They do not focus on the security of the data itself
- For instance the CIS Oracle benchmark for 11g, 12c, 18c, 19c do not cover **YOUR** data at all
- To secure data we must target the security of data
  - **Obviously!!**


# We Must Find All Copies of Data

- To secure data we MUST KNOW where that data is
- If it is processed and stored in a database we need to
  - Located all copies
  - Locate all part copies
  - Think about how the database works and include system files, logs, trace, …
  - Locate all backups
  - Locate all reports
  - Locate all output created by users, devs, DBAs and more
  - …
- When we know the location of data we can take action


# Layers of Data Security

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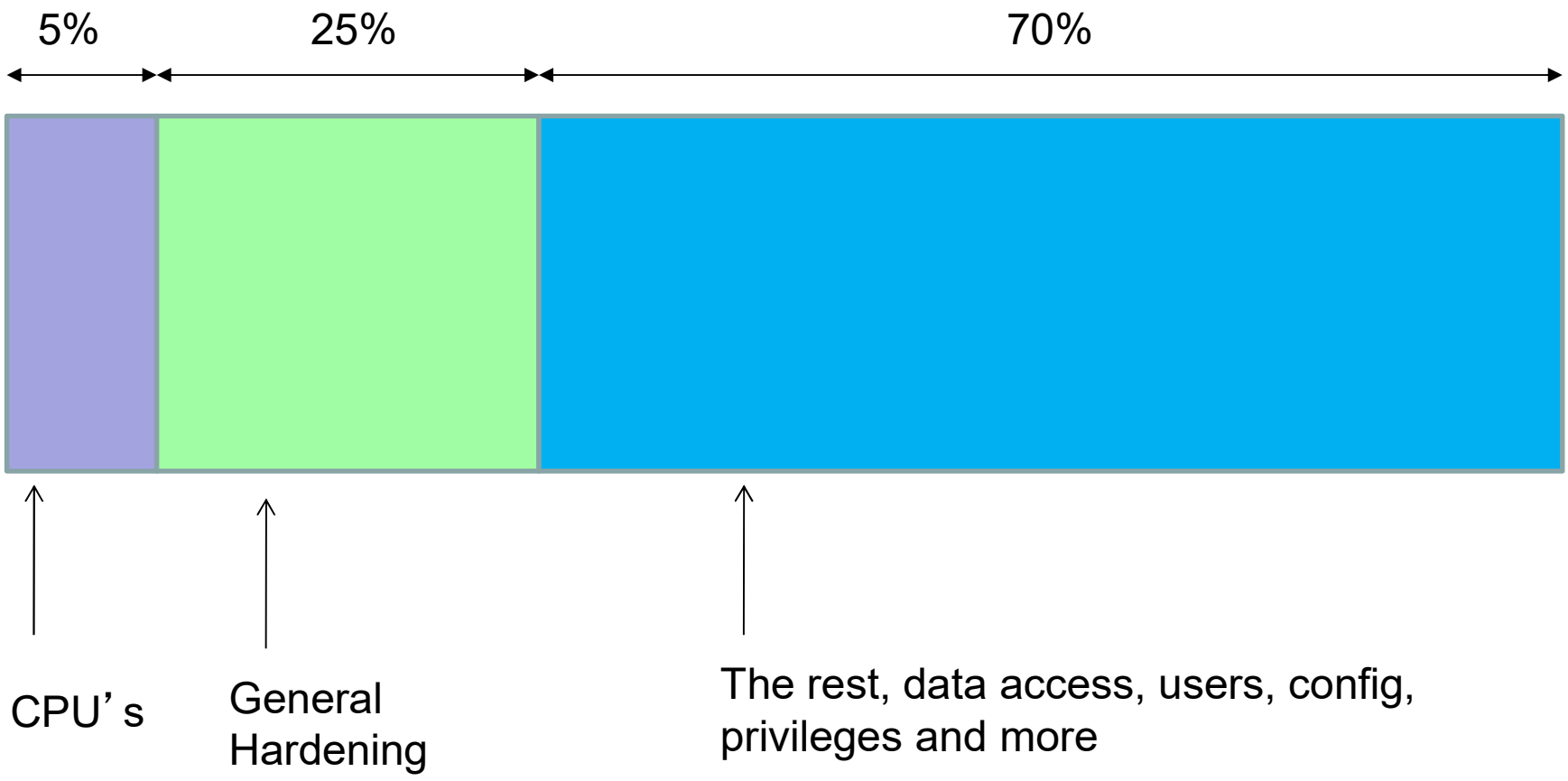
# Compartmentalise Data Security?



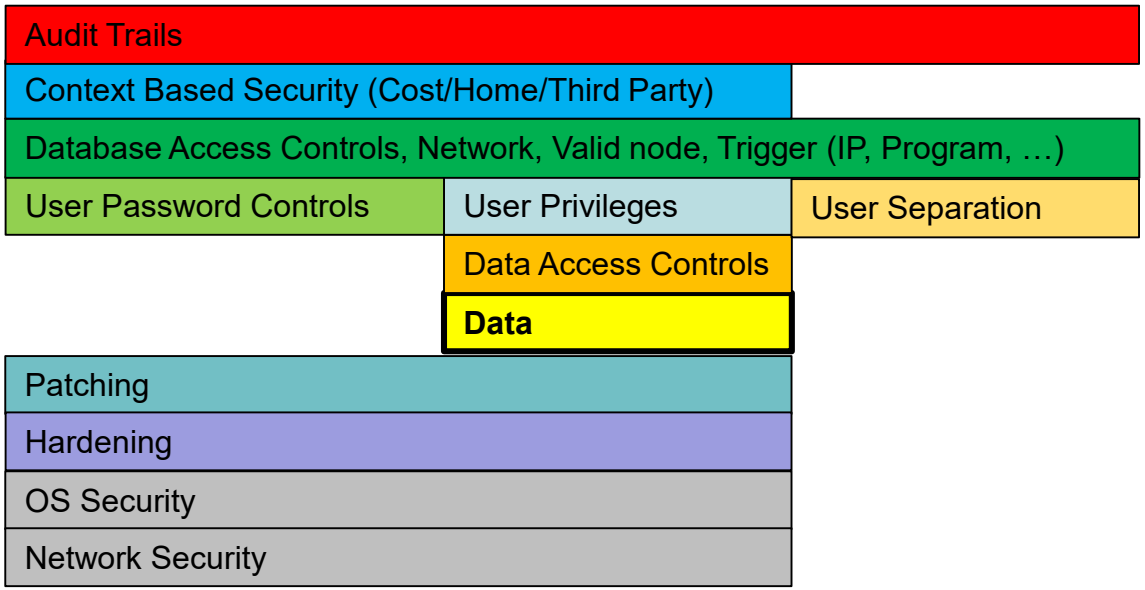

# Lets Expand On the Sections

- Platform security
  - Security patching
  - Database Hardening
  - Database access controls
- Data security design
  - User security (least rights)
  - Data security (access controls)
  - Context based security


# Data Security

- The “Data Security” section can be further split into
  - User access controls
  - User privilege – aim for “least privilege”
  - Data access controls
  - Context based security
  - Advanced security
  - Adaptive security
  - Audit trails

# Expand into Layers of Data Security




# Security Options

- Oracle (the database) security features are immense:
  - Parameters and privileges on everything
  - Audit trails and lockdown profiles
  - User profiles and more
- Core database must be secured first
- SE, EE all include **almost** all core security features
- In general Oracle Security solutions from Oracle cost additional fees
- In general these security products are not available to licensed users of SE / SE1 / SE2
- Some security solutions are available with the Enterprise Edition (VPD) included with the license
- Most of these tools / products are declarative – i.e. they include a framework PL/SQL API that lets you declare policies and settings
  - Some also include GUI tools in OEM / Cloud Control


# Patching and Hardening


Many Names: CPU (Critical Patch Update), SPU (Security Patch Update), PSU (Patch Set Update), many more...

# Patch The Database

- There is a tendency across the industry not to patch Oracle
- Statistics – 30% of 30% patch regularly (**I ask regularly**)
- There are many ways to test patches – checksums, date time stamps on binaries BUT use DBA_REGISTRY_HISTORY since 9.2.0.6 and DBA_REGISTRY_SQLPATCH and DBMS_QOPATCH from 12c
- All databases “should” be patched to the same level (dev, test, uat…), often not the case
- Regression testing can be a problem – test limited systems?
- There must be a formal policy and process to patch
  - Windows approach, wait, apply the last patch..
  - Apply to all in a regular manner – {n}, {n-1}, {n-2}..


# Harden The Database

- Start with CIS **but go much further**
- Remove default users and features
- Change security parameters
- Remove grants on PL/SQL, views, tables
- Lock down the listener
- Add password profiles
- Add a designed DBA role
- Default passwords
- Limit COMMON rights
- Use lockdown profiles


# Users, Passwords and Access

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# Use Access

- I realised a long time ago that if we don't let people connect to Oracle then its much harder to steal data as then the options are limited to
  - Exploiting Oracle binaries or
  - Exploiting an application
  - Or stealing credentials
- This limit / control can be
  - Block network access from any location now authorized for a user
    - i.e. FRED can connect between 8am and 5pm Monday to Friday from IP….
  - Ensure that logons are limited to only those that need them

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# Password Profiles

- All interactive users can have a profile to enforce strong passwords – **no excuse**
- Schemas where the password is embedded then move the password to "/" and use a password wallet the – **take the password change hit once!**
  - Don't have a verify function and no life time
  - Don't have a life time and no verify function
  - Be careful of grace time
- Ensure all passwords are force changed
- Many more…


# Least Privilege


# User Security

- In my experience of security auditing Oracle databases most users have the opposite of least privilege
- User accounts in databases should be designed to have exactly the privileges needed to do their job
- DBAs should not use DBA roles or system users
- Remove all duplicate users; users that are not used
- Remove excessive rights (system rights, Oracle roles, grants)
- Sod and CoI
- Remove duplicates privileges and create separation
- Applies to DBA, support, third party, normal users and release


# Data Access Controls


In the same way that users should have the least rights the controls to access data should be in the same way

# Data Access Controls

- We must have access controls that lock the data to everyone (**deny all**) and then open the access only to the users that need it
- Table permissions are very granular a permission granted to a user is there all the time
- Table permissions to a role are there all the time but the role can be remove or disabled
- Data domains – allow privilege design and separate schemas
- Connection users (not to the schema) and lock schemas
- Ensure data security is in the database (VPD, RAS, Home grown)
- Control resources and privilege use (API) and separate schema
- Secure the application PL/SQL
- De-duplicate data


# Context Based Security


# Context Based Security

- Add identity – get/set, Oracle does not do this for you
- Add context based access to the database
- Context based DML
- Context based READ of data
- Context based code (API access)
- Implement Breakglass


# What Do Cost Options Do?

- In general the cost options can provide deeper security or granularity or both
- Most cost options can be simulated to some level
  - DV (don't use the DBA role, use triggers and functions and more ) for realms
- Some cannot as easily be simulated
  - TDE, ASO native encryption
- If we do for free there are gaps but it's the only option in SE for instance


Third party security solutions are also available (for a cost)

# Additional Security Cost Options

- Database Vault – primary tool to protect against privilege accounts and to put realms around data/function
- Oracle Label Security - Allows data to be accessed by row level labels and the users current label access level
- Data Redaction (ASO) – Redact some data from end users – black like through data!
- Transparent Sensitive Data Protection – create classes of sensitive data to allow more centralised way of protecting sensitive data – uses VPD and Data Redaction
- Transparent Database Encryption – allows data to be encrypted at rest – either at tablespace level or at the column level
- Oracle Data Masking – find data to mangle / obfuscate and specify rules to then change that data – keeping referential integrity
- Audit Vault and Database Firewall– centralised database for audit storage including certificate based confirmation of data


# Secure The Core Database

- Secure the core database first using std features
- **A security cost option is just an application**
- The cost option (security application)
  - Must be configured for your ideas / use. OOTB they usually do not do what you want
  - Security option must be secured as well
    - The interfaces, API, metadata, custom code
    - i.e. in VPD if you make the predicate function public anyone can run it or if a user has ALTER SYSTEM then can set events 10060 or 10730


Demo: context_dml.sql

# Context - DML Triggers

- Tables have a set of privileges granted to allow access to the credit data stored there but often this is not fine grained enough
- If we also want to prevent my ORABLOG user from changing, adding or deleting their own data we can use DML triggers – i.e. the application did not do the change
- The intention is to allow updates, inserts and deletes only from the BOF interface
- Therefore we can limit DML to only occur via the right interface
- All of these solutions need additional layers to prevent the solution from being removed and audit should be enabled


# Adaptive Security


# Adaptive Security

- No one really does this in Oracle but it is an interesting idea
- Create multiple levels of security defcon5, 4, 3, 2,1
- Use context based security
- Use audit as the identifier / trigger
- Run database under limited security normally day to day
  - Detect an attack using audit or other means
  - Enable much stronger levels of security in the current database
  - Transmit this knowledge to other databases
    - Use link or messaging or…
    - Enable stronger security across all databases
  - **Risk; an attacker can simulate an attack to change security**


# Audit Trails


# Audit Trails

- Most sites do not use Oracle audit trails that I visit
- It is hard to set up a useful audit trail
- There are thousands and thousands of combinations of settings
- Set up basic audit trails that capture at least
  - Connections
  - User, role, profile, grant
  - Changes to configuration
  - Changes to security
  - Use of critical functionality or data
  - An attack i.e. SQL Injection


# Work to a Plan


In general you cannot just turn something ON or OFF unless you think about every consequence first – this does not mean we should not do it

# Security Can be Complex

- There are many possible gotchas that need to be considered as part of securing data in Oracle
- Adding layers of security can make access / work harder if not planned properly (password cannot be remembered if its no longer 3 characters!!)
- Security is also about people i.e.;
  - DBAs must not use SYSDBA therefore you must define a suitable set of privileges for daily use
  - Support or release must not use the schema paswd therefore lock the schema, use proxy and change release processes


# Create a Data Security Policy

- Do not create hardening guides or use guides such as CIS that focus only on hardening and patching
- Create a data security policy
  - A global business policy first
  - Can have sections focused on each Database and server platform
  - Must have rules that limit access and control access to data no matter the storage (Database, file system, …)
  - Include patching, hardening, data security, even adaptive security
  - **Understand your budget**


# Conclusions

- Focus on data first
- Find the data
- Build layers of security around the data
- Consider the budget
- Be clever and target layers to spend less and achieve more


# Questions

?


# Create Onion Layers of Security

## Around Your Data