Oracle Database Security Master Class: Live in SQL*Plus

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Introduction

Daniel Morgan

- Oracle ACE Director
- Oracle Educator
  - Curriculum author and primary program instructor at University of Washington
  - Consultant: Harvard University
  - University Guest Lecturers
    - APAC: University of Canterbury (NZ)
    - EMEA: University of Oslo (Norway)
    - Latin America: Universidad Latina de Panama and Technologico de Costa Rica
- IT Professional
  - First computer: IBM 360/40 in 1969: Fortran IV
  - Oracle Database since 1988-9
  - Beta Tester 10g, 11g, 12c, TimesTen, GoldenGate
  - The Morgan behind www.morganslibrary.org
  - Member Oracle Data Integration Solutions Partner Advisory Council
  - Co-Founder International GoldenGate Oracle Users Group
- Principal Adviser: Forsythe **Meta7**

System/370-145 system console

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Zero Downtime Database Migrations with GoldenGate

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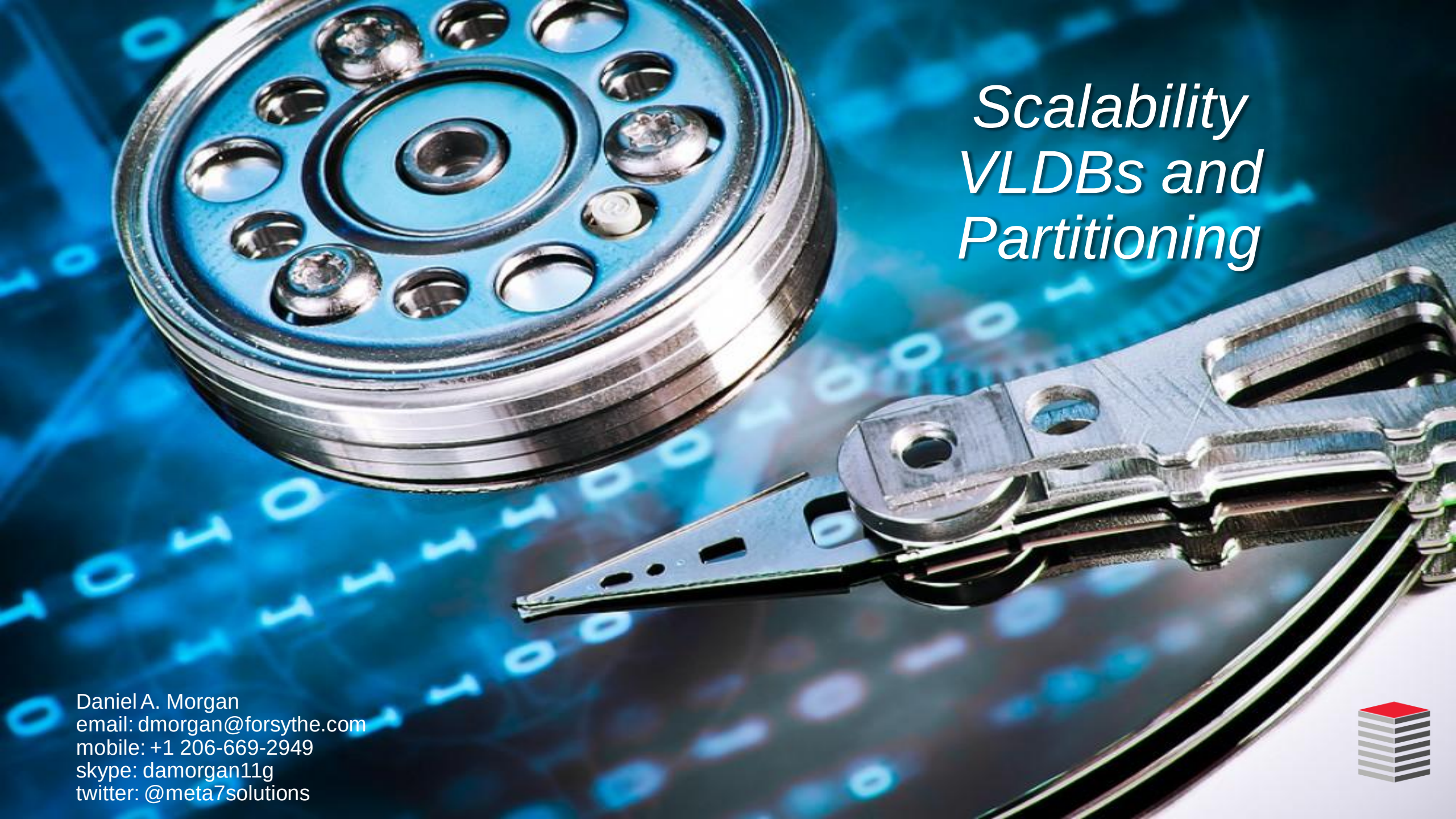

Scalability VLDBs and Partitioning

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Database Performance

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IT Fire Fighting

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Oracle DBaaS Migration

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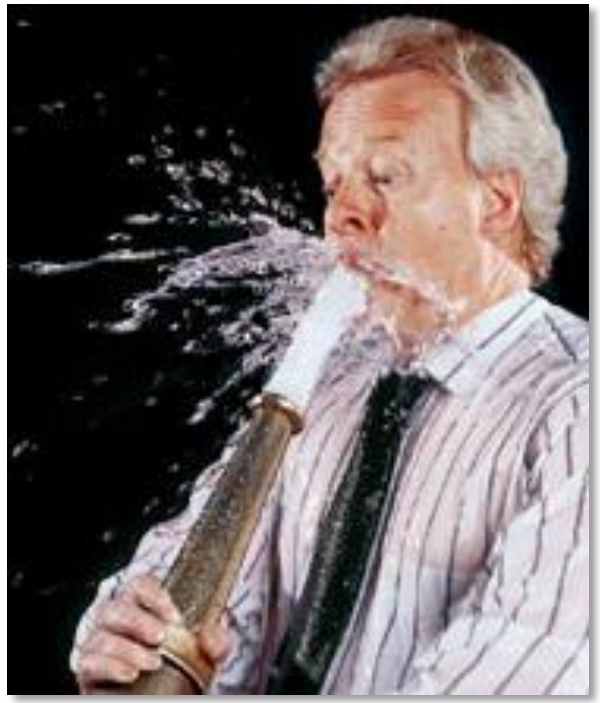
Content Density Warning



Take Notes ... Ask Questions

Rhetorical Question

- Would you want your surgeon to practice 1990s medicine?

- Then why are you configuring database security the way you did in the 90's?

Why Am I Focusing On Oracle Database Security?

- Because what OEM's talk about is products you can buy
- Because no one teaches operational security to Application Developers
- Because no one teaches operational security to System Admins
- Because no one teaches operational security to DBAs
- Because no one teaches operational security to IT Management
- Because what most organizations implement can be by-passed within minutes
- Which should be incredibly obvious given the number of systems broken into every day

Presentation Caveats

- This presentation is incomplete ... it is a subset of basic, built-in, free functionality extracted from a 5 day hand's-on class
- Lots of people enable auditing ... but essentially no one actually reads the audit logs until after something really bad has happened
- So auditing is almost irrelevant to security

The Concept

- To achieve a secure environment you must embrace the fact that the goal is not to limit access but rather it is to secure data
- Securing access is a step in the right direction but it does little to secure data

If someone had unfettered access to your entire network for a year but couldn't get to your data ... there would be no risk!

- There is always someone inside the firewall, always someone with access, but there is a big difference between accessing one record ...

... and walking away with all of the records

The Business Case

Unlike much of the Oracle Database's highly targeted functionality security is a broad topic touching every aspect of the environment from infrastructure to configuration to tools as well as the human element: Processes and procedures

Background

- When discussing security and auditing it is important that we understand, with clarity, what we must achieve
  - Compliance with government and industry regulations
  - Pass both internal and external audits
  - Meet contractually agreed-to terms
  - Protect internal proprietary data and secrets
  - Detect and thwart activities that threaten to compromise our organization while they are in-progress not after they happened
  - Detect activities that threaten to compromise the organization after they have occurred so we can develop strategies and techniques that will prevent them in the future and to identify, specifically, what has been accessed and what has been compromised
  - Auditing is NOT security and will not be covered today

Office of the
Privacy Commissioner
of Canada

Expanding Regulatory Requirements

AMERICAS

- SarbOx
- HIPAA
- PCI
- FDA CFR 21 Part 11
- OMB Circular A-123
- SEC and DoD Records Retention
- DFARS
- USA Patriot Act
- Gramm-Leach-Bliley Act
- Federal Sentencing Guidelines
- Foreign Corrupt Practices Act
- Market Instruments 52 (Canada)

EMEA

- EU Privacy Directives
- UK Companies Law

APAC

- J-SOX (Japan)
- CLERP 9: Audit Reform and Corporate Disclosure Act (Australia)
- Stock Exchange of Thailand Code on Corporate Governance

GLOBAL

- International Accounting Standards
- Basel II (Global Banking)
- OECD Guidelines on Corporate Governance

Internal vs. External Threats

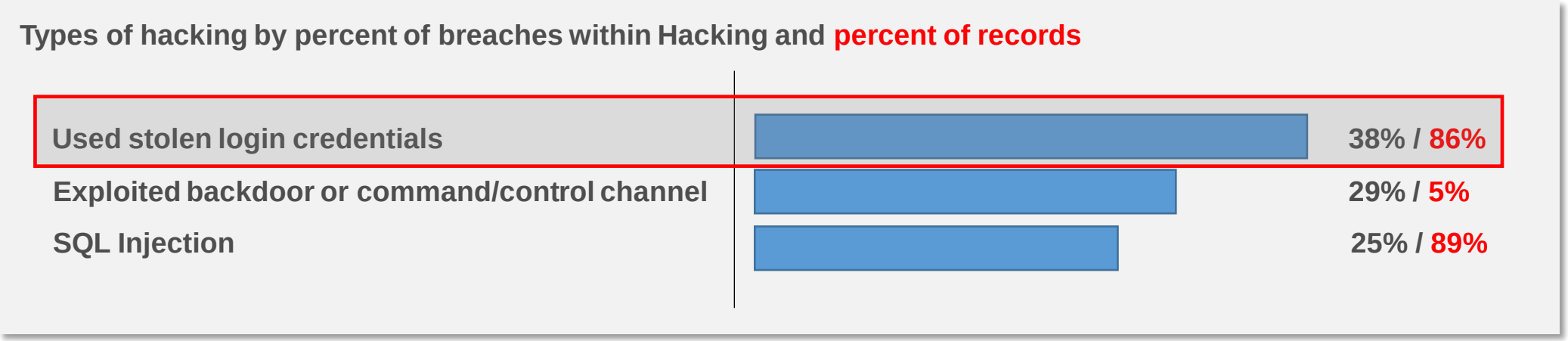
- Most organizations focus on the least likely threats and ignore what has been historically proven to be the largest threat
- The following is quoted from "Reference for Business" on the subject of computer crimes

> **As criminologist and computer-insurance executive Ron Hale indicated to Tim McCollum of *Nation's Business*, one of the most unsettling facts about computer crime is that the greatest threat to information security for small businesses is their employees. As McCollum noted, "a company's employees typically have access to its personal computers and computer networks, and often they know precisely what business information is valuable and where to find it." The reasons for these betrayals are many, ranging from workplace dissatisfaction to financial or family difficulties.**

- When organizations focus on their firewall they are focusing on what is often the most expensive, yet least effective, protection against data theft
- Part of our job is to provide solutions that address vulnerabilities to minimize our customer's risk exposure
- The other part is educational ... to educate our customers, internal and external, on the nature of real-world threats

Real World Threats: How Database Breaches Really Occur

- 48% involve privilege misuse
- 40% result from hacking



- 38% utilized malware
- 28% employed social engineering
- 15% physical attacks

Percentages do not add up to 100% because many breaches employed multiple tactics in parallel or were outliers

Misdirected By The Media

- What does any of this have to do with securing data?
- Nothing
- All of this is focused on how cyber-criminals get the login credentials
- Not one byte relates to how, once credentials are stolen the data can be protected

- Business E-mail Compromise
  Thu, 22 Jan 2015
- University Employee Payroll Scam
  Tue, 13 Jan 2015
- Scam Targeting University Students
  Tue, 13 Jan 2015

No companies products, by default, are secure. Oracle products, by default, are not secure. But Oracle's products contain the tools and technology you can employ that will make them secure.

Oracle's Solutions

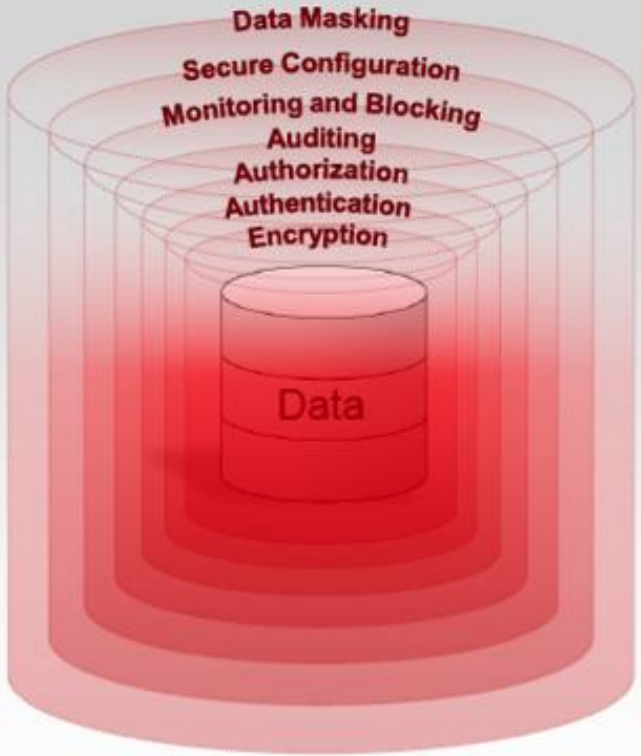
What The Leading Oracle Expert Says

Oracle's Larry Ellison decries poor state of security,

"We need much better security," Ellison said Tuesday in a speech at Oracle OpenWorld. "We need a next generation of security because we're not winning a lot of these cyberbattles. We haven't lost the war, but we're losing a lot of battles."

An Oracle Corporate View of Security

- Very valuable ... but insufficient



- Oracle Advanced Security
- Oracle Identity Management
- Oracle Database Vault
- Oracle Label Security
- Oracle Audit Vault
- Oracle Total Recall
- Oracle Database Firewall
- Oracle Configuration Management
- Oracle Data Masking

Comprehensive – Transparent – Easy to Deploy – Proven!

- Security requires that you implement what is free too

Oracle Security Products

- Oracle provides an extensive range of security products. Some focused solely on the database others focused on the entire technology stack: Among them
  - Monitoring and Blocking
    - Database Firewall
  - Auditing and Tracking
    - Oracle Total Recall
  - Access Control
    - Oracle Identity Management (OID)
    - Oracle Database Vault
    - Oracle Label Security
  - Encryption and Masking
    - Oracle Advanced Security
    - Oracle Secure Backup
    - Oracle Data Masking
- This presentation will focus solely on the Oracle Database with a default installation

SPARC T7 + Meta7 = x ... solve for x

X = 'Stability + Security + Scalability'

- With SPARC M7 we get Security on Silicon
  - SPARC M7 features co-processors dedicated to Oracle Database and Java processes
  - Many database functions bypass the general pool of cores and run on dedicated co-processors
  - Software in Silicon is yielding 10x improvement when the same workload is compared on the T5/M6 and M7 platforms
  - Nothing needs to be done to leverage the feature ... It is automatically enabled by the database software when it is run on SPARC M7 processors
  - No other vendor can do this because it is SPARC M7 specific
  - Oracle databases running on non-Oracle servers require several times the processing capacity to do the same amount of work
  - SQL queries, Encryption, Compression/Decompression all take advantage of the Software in Silicon features
- This means fewer cpu licenses to get the job done

SPARC T7 + Meta7 = x ... solve for x

- But let's focus on the security aspects of the M7 chipset
  - Real-time data integrity checking to protect against pointer-related software errors and malware
  - First-ever hardware-based memory protection preventing buffer overruns and memory allocation errors
  - OS-level (pointer) and physical (allocated memory) integration prevents accidental or malicious buffer overruns or allocation errors
    - A pointer can not access memory which does not share a key
    - Protects against memory-related bugs and exploits such as Heartbleed
    - Eliminates allocations errors that can result in OS failsafe panics
    - Silicon Secured Memory contains the impact of the overrun or error to just the offending process

Securing Access

Networks and Storage

Database Networks

- Every Oracle Database deployment may require multiple network connections: Here is a full listing

Name	Protocol	Utilization
Management	TCP/IP	System Admin connection to the server's light's-out management card
Public	TCP/IP	Access for applications, DBAs, exports, imports, backups: No keep-alive if RAC
SAN Storage	Fibre Channel	Server connection to a Storage Area Network (SAN)
NAS Storage	TCP/IP or IB	Connection to an NFS or DNFS mounted storage array
RAC Cache Fusion interconnect	UDP or IB	Jumbo Frames, no keep-alive, with custom configured read and write caching
Replication	TCP/IP	Data Guard and GoldenGate
Backup and Import/Export	TCP/IP	

- Every one of these networks provides access to critical infrastructure
- And no conversation of networking is complete without considering Firewalls DNS, and NTP (time) Servers
- This includes the connections from your application servers to your database

Firewalls (1:2)

- Many organizations think they are protected because they have invested a in a firewall
- The following example is real and came from a customer security audit
- The firewall's configuration, discovered during the audit, allowed direct access from the internet to the organization's database servers
- The organization's employees did not fully understand the implications of the rules they were writing

```
ICMP Allowed from outside to Business-Data Zone

set security policies from-zone UNTRUST to-zone Business-Data policy BD-Ping match source-address any

set security policies from-zone UNTRUST to-zone Business-Data policy BD-Ping match destination-address any

set security policies from-zone UNTRUST to-zone Business-Data policy BD-Ping match application junos-ping

set security policies from-zone UNTRUST to-zone Business-Data policy BD-Ping then permit

set security policies from-zone UNTRUST to-zone Business-Data policy BD-Ping then log session-close
```

Firewalls (2:2)

- The fact that a firewall has been configured purchased and configured should give you no sense of comfort
- Here is another firewall rule set and real comments
- The example cancels the stateful feature of the firewall and make it just like a switch or router with security rules (ACLs)
- All traffic is allowed both from/to the outside interface with a security level 0

```
dc-fwsm-app configurations

1094 access-list INBOUND-CAMPUS extended permit ip any any
3735 access-group INBOUND-CAMPUS in interface OUTSIDE
1096 access-list OUTBOUND-CAMPUS extended permit ip any any
3736 access-group OUTBOUND-CAMPUS out interface OUTSIDE

dc-fwsm-db configurations

access-list INBOUND-CAMPUS extended permit ip any any
access-group INBOUND-CAMPUS in interface OUTSIDE

access-list OUTBOUND-CAMPUS extended permit ip any any
access-group OUTBOUND-CAMPUS out interface OUTSIDE
```

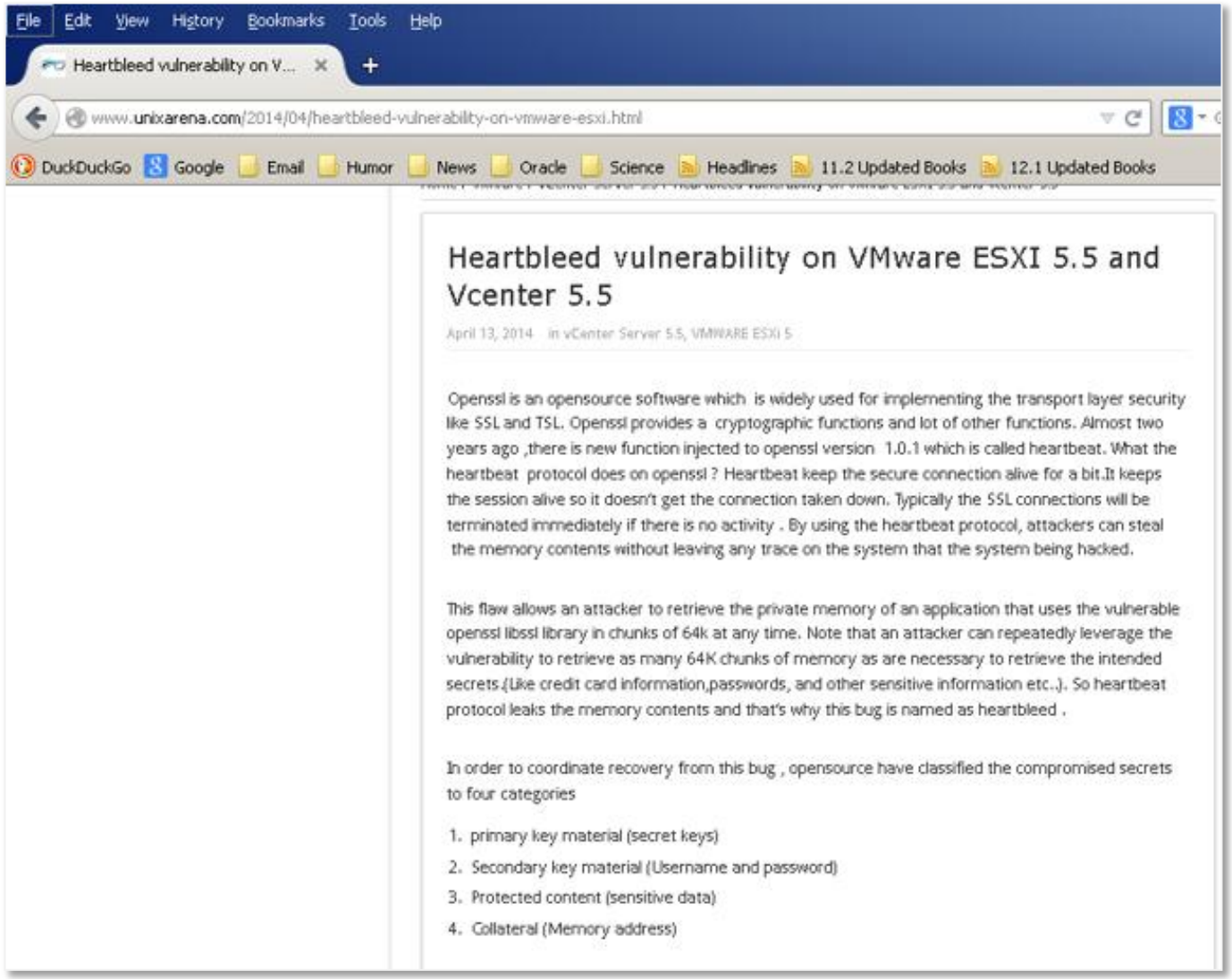
Database Storage

- The object is to protect the data
- To do this you must protect
  - Data Files (both file systems and ASM)
  - Standby Databases
  - Archived redo logs
  - On-site Backups
  - Courier shipments
  - Exports
  - RMAN scripts
  - Data Pump export and import scripts
  - Shell scripts and cron jobs
  - Replication tools such as GoldenGate, ODI, Informatica
  - Used storage drives
  - The entire $ORACLE_BASE file system
    - /rdbms/admin directory
    - Trace files

Operating Environments

Virtual Machines (1:2)

- Virtual machines are not more secure than any other operating environment
  - Implement regular password changes as a matter of policy and procedure
  - Force password complexity
  - Track the names of all persons with access to the password
  - Determine whether ESXi Credentials in use and if not implement them
  - Regularly review logs that live, by default, in the vmdk hypervisor



Virtual Machines (2:2)

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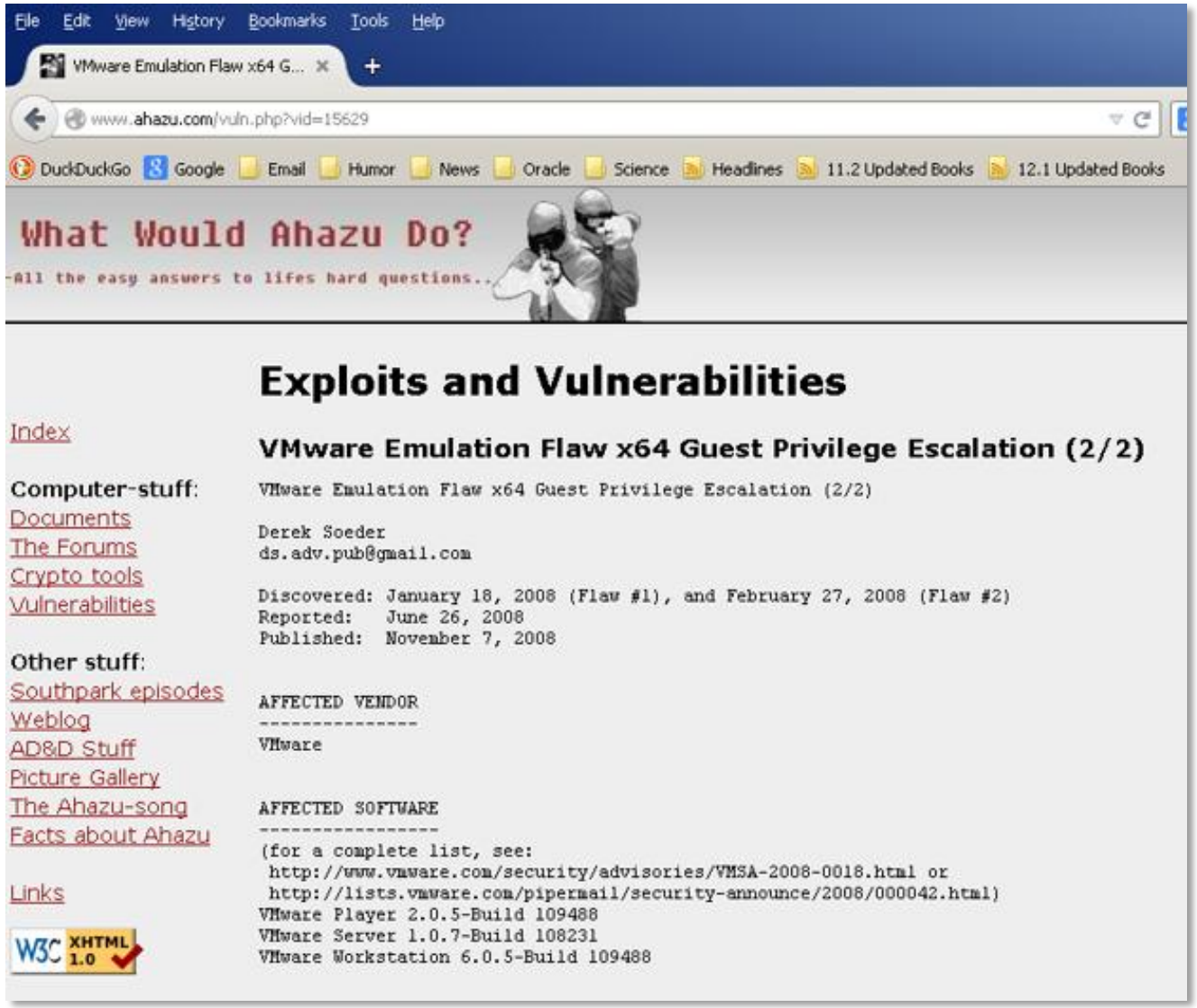


Operating System Configuration

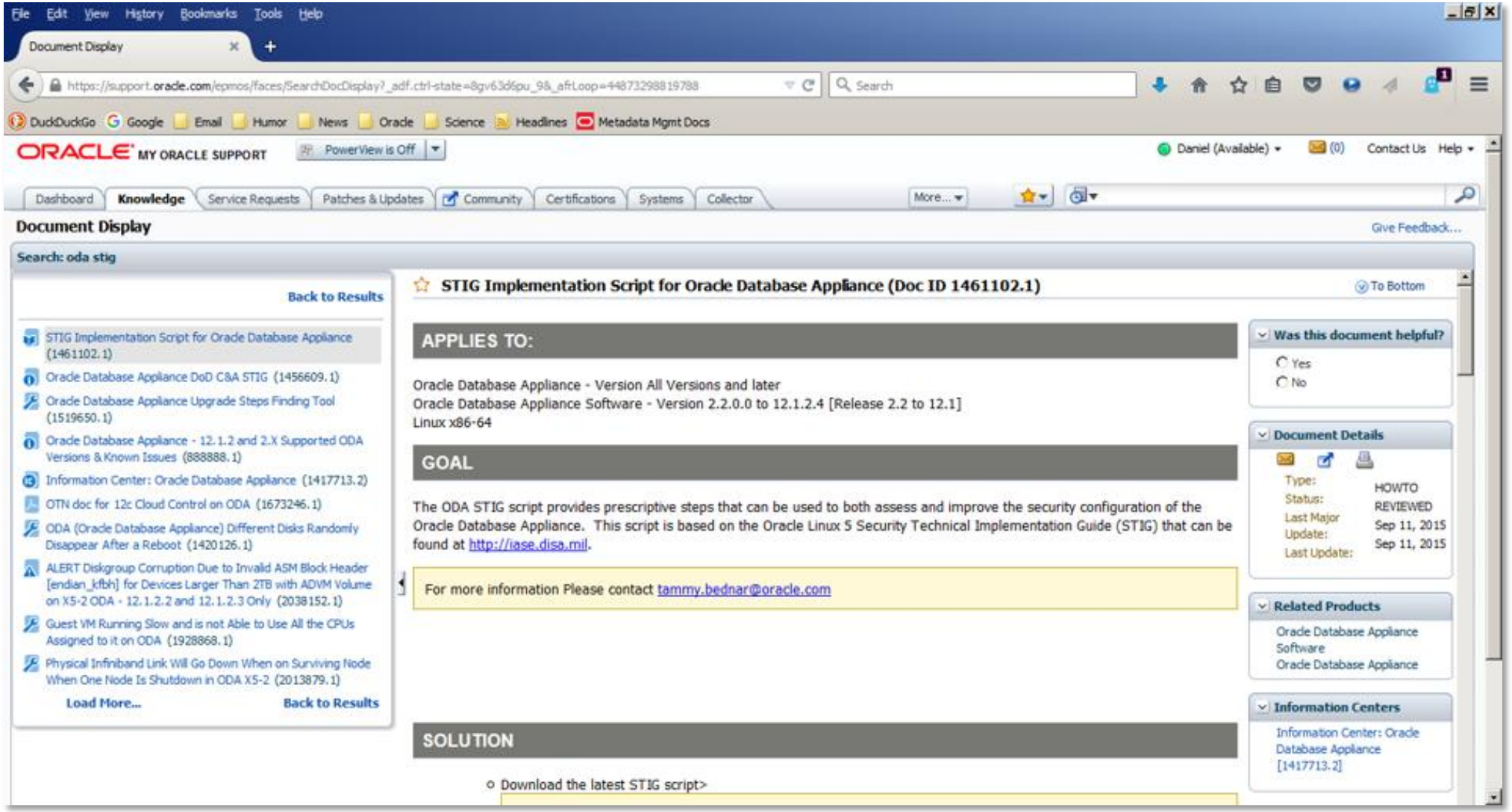
- As a server boots it needs to know the mapping of some hostnames to IP addresses before DNS can be referenced
- The mapping is kept in the `/etc/hosts` file
- In the absence of a name server, a network program on your system consults this file to determine the IP address that corresponds to a host name
- Be sure that the file does not contain any mappings that are not essential ... unnecessary mappings compromise security

```
# Do not remove the following line, or various programs that require network functionality will fail.
::1 localhost6.localdomain6 localhost6

192.168.17.24 orclsys1-priv1.example.com orclsys1-priv1
192.168.17.25 orclsys2-priv1.example.com orclsys2-priv1

#SCAN IP
192.0.2.16 orclsys-scan.example.com orclsys-scan

192.168.17.24 orclsys1-priv1.example.com orclsys1-priv1
192.168.17.25 orclsys2-priv1.example.com orclsys2-priv1

#SCAN IP
192.0.2.22 orclsys-scan.example.com orclsys-scan

192.168.17.24 orclsys1-priv1.example.com orclsys1-priv1
192.168.17.25 orclsys2-priv1.example.com orclsys2-priv1

#SCAN IP
192.0.2.22 orclsys-scan.example.com orclsys-scan

# Following added by OneCommand
127.0.0.1 localhost.localdomain localhost

# PUBLIC HOSTNAMES

# PRIVATE HOSTNAMES
192.168.16.24 orclsys1-priv0.example.com orclsys1-priv0
192.168.16.25 orclsys2-priv0.example.com orclsys2-priv0
192.168.17.24 orclsys1-priv1.example.com orclsys1-priv1
192.168.17.25 orclsys2-priv1.example.com orclsys2-priv1

# VIP HOSTNAMES
192.0.2.20 orclsys1-vip.example.com orclsys1-vip
192.0.2.21 orclsys2-vip.example.com orclsys2-vip

# NET(0-3) HOSTNAMES
192.0.2.18 orclsys1.example.com orclsys1
192.0.2.19 orclsys2.example.com orclsys2

#SCAN IP
192.0.2.22 orclsys-scan.example.com orclsys-scan
```

STIG (1:2)

- A STIG is a Security Technical Implementation Guide produced or approved by the US Department of Defense
- Oracle has published STIGs at My Oracle Support for Exadata and ODA
  - But the "CHECK" option can be run on any Linux server
- Oracle Support provides a downloadable script that can be used to check an ODA against STIG requirements and identify three levels of violations
- We strongly recommend running the script with the **`-check`** option but recommend having your Linux System Admin correct those issues you wish to correct manually rather than running with the **`-fix`** option: The "fix" may be more extreme than you expect

STIG (2:2)


File Edit View History Bookmarks Tools Help
Document Display
https://support.oracle.com/epmos/faces/SearchDocDisplay?_adf.ctrl-state=8gv63d6pu_9&_afrLoop=4487329881978
DuckDuckGo Google Email Humor News Oracle Science Headlines Metadata Mgmt Docs
ORACLE MY ORACLE SUPPORT
PowerView is Off
Daniel (Available)
Contact Us Help
Dashboard Knowledge Service Requests Patches & Updates Community Certifications Systems Collector More...
Document Display
Give Feedback...
Search: oda stig
Back to Results
STIG Implementation Script for Oracle Database Appliance (1461102.1)
Oracle Database Appliance DoD C&A STIG (1456609.1)
Oracle Database Appliance Upgrade Steps Finding Tool (1519650.1)
Oracle Database Appliance - 12.1.2 and 2.X Supported ODA Versions & Known Issues (888888.1)
Information Center: Oracle Database Appliance (1417713.2)
OTN doc for 12c Cloud Control on ODA (1673246.1)
ODA (Oracle Database Appliance) Different Disks Randomly Disappear After a Reboot (1420126.1)
ALERT Diskgroup Corruption Due to Invalid ASM Block Header [endian_kfbh] for Devices Larger Than 2TB with ADVM Volume on X5-2 ODA - 12.1.2.2 and 12.1.2.3 Only (2038152.1)
Guest VM Running Slow and is not Able to Use All the CPUs Assigned to it on ODA (1928868.1)
Physical Infiniband Link Will Go Down When on Surviving Node When One Node Is Shutdown in ODA X5-2 (2013879.1)
Load More...
Back to Results
STIG Implementation Script for Oracle Database Appliance (Doc ID 1461102.1)
To Bottom
APPLIES TO:
Oracle Database Appliance - Version All Versions and later
Oracle Database Appliance Software - Version 2.2.0.0 to 12.1.2.4 [Release 2.2 to 12.1]
Linux x86-64
GOAL
The ODA STIG script provides prescriptive steps that can be used to both assess and improve the security configuration of the Oracle Database Appliance. This script is based on the Oracle Linux 5 Security Technical Implementation Guide (STIG) that can be found at http://iase.disa.mil.
For more information Please contact tammy.bednar@oracle.com
SOLUTION
Download the latest STIG script>
Was this document helpful?
Yes
No
Document Details
Type: HOWTO
Status: REVIEWED
Last Major Update: Sep 11, 2015
Last Update: Sep 11, 2015
Related Products
Oracle Database Appliance Software
Oracle Database Appliance
Information Centers
Information Center: Oracle Database Appliance [1417713.2]

Database Deployment

Net Services Security

- Here's what Oracle says about Net Services aka SQL*Net

> Local listener administration is secure through local operating system authentication, which restricts listener administration to the user who started the listener or to the super user. By default, remote listener administration is disabled.

- For secure communications you need to consider the following parameters (some of which require the Advanced Security Option)
  - NAMES.LDAP_AUTHENTICATE_BIND
  - NAMES.LDAP_CONN_TIMEOUT
  - NAMES.LDAP_PERSISTENT_SESSION
  - SQLNET.ALLOWED_LOGON_VERSION_CLIENT
  - SQLNET.ALLOWED_LOGON_VERSION_SERVER
  - SQLNET.AUTHENTICATION_SERVICES
  - SQLNET.CLIENT_REGISTRATION
  - SQLNET.CRYPTO_CHECKSUM_CLIENT
  - SQLNET.CRYPTO_CHECKSUM_SERVER
  - SQLNET.CRYPTO_CHECKSUM_TYPES_CLIENT
  - SQLNET.CRYPTO_CHECKSUM_TYPES_SERVER
  - SQLNET.ENCRYPTION_CLIENT
  - SQLNET.ENCRYPTION_SERVER
  - SQLNET.ENCRYPTION_TYPES_CLIENT
  - SQLNET.ENCRYPTION_TYPES_SERVER
  - SQLNET.EXPIRE_TIME
  - SQLNET.INBOUND_CONNECT_TIMEOUT
  - SSL_CERT_REVOCATION
  - SSL_CERT_FILE
  - SSL_CERT_PATH
  - SSL_CIPHER_SUITES
  - SSL_EXTENDED_KEY_USAGE
  - SSL_SERVER_DN_MATCH
  - SSL_VERSION
  - TCP.CONNECT_TIMEOUT
  - WALLET_LOCATION

Oracle Listener Port

- Have you changed the default port of your database from 1521 to something else to thwart an attack?
- Netstat can narrow down the choices an attack must check in a single command

```
[oracle@gg00a dirprm]$ netstat -lntu
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 0.0.0.0:5801            0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:5901            0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:111             0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:6001            0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:56754           0.0.0.0:*               LISTEN
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:631           0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:25            0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.1:2208          0.0.0.0:*               LISTEN
tcp        0      0 :::47406                :::*                    LISTEN
tcp        0      0 :::1526                 :::*                    LISTEN
tcp        0      0 :::6001                 :::*                    LISTEN
tcp        0      0 :::7809                 :::*                    LISTEN
udp        0      0 0.0.0.0:5353            0.0.0.0:*
udp        0      0 0.0.0.0:111             0.0.0.0:*
udp        0      0 0.0.0.0:627             0.0.0.0:*
udp        0      0 0.0.0.0:630             0.0.0.0:*
udp        0      0 0.0.0.0:631             0.0.0.0:*
udp        0      0 0.0.0.0:34070           0.0.0.0:*
udp        0      0 0.0.0.0:68              0.0.0.0:*
udp        0      0 0.0.0.0:45534           0.0.0.0:*
udp        0      0 :::5353                 :::*
udp        0      0 :::49517                :::*
udp        0      0 ::1:63872               :::*
udp        0      0 ::1:39693               :::*
udp        0      0 :::59798                :::*
udp        0      0 ::1:19812               :::*
```

DDOS Attack

- A Distributed Denial of Service attack can make a database unusable by flooding it with connection requests
- The connection rate limiter feature in Oracle Net Listener enables a DBA to limit the number of new connections handled by the listener
- When enabled, Oracle Net Listener imposes a user-specified maximum limit on the number of new connections handled by the listener every second. Depending on the configuration, the rate can be applied to a collection of endpoints, or to a specific endpoint

```
LISTENER=
(ADDRESS=(PROTOCOL=tcp)(HOST=)(PORT=1521)(RATE_LIMIT=yes))

LISTENER= (ADDRESS_LIST=
   (ADDRESS=(PROTOCOL=tcp)(HOST=)(PORT=1521)(RATE_LIMIT=5))
   (ADDRESS=(PROTOCOL=tcp)(HOST=)(PORT=1522)(RATE_LIMIT=10))
   (ADDRESS=(PROTOCOL=tcp)(HOST=)(PORT=1523))
)
```

```
CONNECTION_RATE_LISTENER=10
  LISTENER=
     (ADDRESS_LIST=
     (ADDRESS=(PROTOCOL=tcp)(HOST=)(PORT=1521)(RATE_LIMIT=yes))
     (ADDRESS=(PROTOCOL=tcp)(HOST=)(PORT=1522)(RATE_LIMIT=yes))
     (ADDRESS=(PROTOCOL=tcp)(HOST=)(PORT=1523)))
```

SQLNET.ALLOWED_LOGON_VERSION

- Specifies the minimum client version that is allowed to connect to the database
- Someone with a valid userid and password, but the wrong Oracle client version is prevented from making a connection

Explanation	Set the login version to 11. The higher setting prevents logins by older version clients that do not use strong authentication to pass the login credentials.
Validation	`grep -i ALLOWED_LOGIN_VERSION sqlnet.ora`
Finding	Allowed logon version not configured.
Action	Set **`SQLNET.ALLOWED_LOGON_VERSION=11`** to restrict access to version 11 clients.

Valid Node Checking (1:2)

- 38% of breaches are performed with stolen credentials ... 86% of records stolen are from breaches with stolen credentials
- To prevent someone with a valid userid and password from gaining access enable Valid Node Checking in your SQLNET.ORA file

```
valid_node_checking_registration_listener=on

tcp.invited_nodes=(sales.meta7.com, hr.us.mlib.com, 144.185.5.73)

tcp.excluded_nodes=(blackhat.hacker.com, mktg.us.acme.com, 144.25.5.25)
```

- "Best practice" is to hard-code in the IP addresses of
  - Application servers
    - This has the added benefit of forcing the organization to communicate with the DBA team when new application servers are added
    - If a new app server is not added to the invited list it cannot connect to the database
  - Reporting servers (Business Objects, Cognos, Crystal Reports, ...)
  - Replication servers (GoldenGate, Informatica, SharePlex...)
  - Members of the DBA team

Valid Node Checking (2:2)

Explanation	This parameter in SQLNET.ORA causes the listener to matches incoming connection requests to invited and excluded node lists. A valid user-id/password combination is only valid if it comes in from an invited and unexcluded node.
Validation	**`grep -i tcp.validnode_checking sqlnet.ora`**

Finding	Valid node checking not enabled in the current PROD environment. The QA system contains the following:
	
	`VALID_NODE_CHECKING_REGISTRATION_LISTENER_SCAN3=OFF`
	`VALID_NODE_CHECKING_REGISTRATION_LISTENER_SCAN2=OFF`
	`VALID_NODE_CHECKING_REGISTRATION_LISTENER_SCAN1=OFF`
	`VALID_NODE_CHECKING_REGISTRATION_LISTENER = SUBNET`
	`VALID_NODE_CHECKING_REGISTRATION_MGMTLSNR=SUBNET`
	`REGISTRATION_INVITED_NODES_LISTENER_SCAN2=()`
	`REGISTRATION_INVITED_NODES_LISTENER_SCAN3=()`
	
	Which enables SUBNET level valid node checking but given that no lists are provided, see following two slides does not provide any security.

Action	Set **`tcp.validnode_checking=YES`** in $ORACLE_HOME/network/admin/sqlnet.ora

Secure Configuration

- A script run as part of installation that creates a "secure configuration"
- Review the script **`$ORACLE_HOME/rdbms/admin/secconf.sql`**

```
Rem     Secure configuration settings for the database include a reasonable
Rem     default password profile, password complexity checks, audit settings
Rem     (enabled, with admin actions audited), and as many revokes from PUBLIC
Rem     as possible. In the first phase, only the default password profile is included.
```

Can perform the following

- Modifies the Default profile
- Creates audit policy: ORA_ACCOUNT_MGMT
- Creates audit policy: ORA_DATABASE_PARAMETER
- Creates audit policy: ORA_LOGON_FAILURES
- Creates audit policy: ORA_SECURECONFIG
- Creates audit policy: ORA_CIS_RECOMMENDATIONS

- Executed indirectly when **`$ORACLE_HOME/rdbms/admin/catproc.sql`** runs

Startup Initialization Parameters (1:3)

- There are a number of init.ora/spfile parameters that can contribute to creating a more secure environment
  - O7_DICTIONARY_ACCESSIBILITY
  - LDAP_DIRECTORY_ACCESS
  - LDAP_DIRECTORY_SYSAUTH
  - OS_ROLES
  - REMOTE_LISTENER
  - REMOTE_LOGIN_PASSWORDFILE
  - REMOTE_OS_ROLES
  - SEC_CASE_SENSITIVE_LOGON
  - SEC_MAX_FAILED_LOGIN_ATTEMPTS
  - SEC_PROTOCOL_ERROR_FURTHER_ACTION
  - SEC_PROTOCOL_ERROR_TRACE_ACTION
  - SEC_RETURN_SERVER_RELEASE_BANNER
  - SQL92_SECURITY

O7_DICTIONARY_ACCESSIBILITY (1:2)

- Version 7 Dictionary Accessibility support
- Range of values: {FALSE | TRUE}
- The default is FALSE ... monitor for changes

- Recommendation
  - CIS recommends the default value of FALSE

```
ALTER SYSTEM SET O7_dictionary_accessibility = FALSE
COMMENT='Reset to TRUE on 21-APR-2016'
SID='*'
SCOPE=BOTH;
```

O7_DICTIONARY_ACCESSIBILITY (2:2)

Explanation	Set o7_dictionary_accessibility to FALSE to prevent users with EXECUTE ANY PROCEDURE and SELECT ANY DICTIONARY from accessing objects in the SYS schema FALSE is the default. Note: In Oracle Applications 11.5.9 and lower, O7_DICTIONARY_ACCESSIBILITY must be set to TRUE. This is required for proper functioning of the application and Oracle does not support setting it to FALSE. In Apps 11.5.10 and higher, it should be set to FALSE.

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'o7_dictionary_accessibility';`

Finding	Set to FALSE
Action	No action required.

LDAP_DIRECTORY_ACCESS (1:2)

- Specifies whether Oracle refers to Oracle Internet Directory for user authentication information
- If directory access is turned on this parameter also specifies how users are authenticated
- Range of values: {NONE | PASSWORD | SSL}
- The default is 'NONE'

- Recommendation
  - Alter this parameter only in accordance with installation of LDAP provisioning

```
ALTER SYSTEM SET ldap_directory_access = NONE
COMMENT='Reset to TRUE on 21-APR-2016'
SID='*'
SCOPE=BOTH;
```

LDAP_DIRECTORY_SYSAUTH

- Enables or disables directory-based authorization for SYSDBA and SYSOPER
- Range of values: {NO | YES}
- The default is 'no'

- Recommendation
  - Alter this parameter only in accordance with installation of LDAP provisioning

```
ALTER SYSTEM SET ldap_directory_sysauth = no
COMMENT='Reset to no on 21-APR-2016'
SID='*'
SCOPE=SPFILE;
```

OS_AUTHENT_PREFIX

- Creating a userid, in an Oracle database, that bypasses an authentication challenge for a password is an attack vector waiting to be used

Explanation	Set the initialization parameter os_authent_prefix to a null string. OS roles are subject to control outside the database. The duties and responsibilities of DBAs and system administrators should be separated. It must be set to limit the external use of an account to an IDENTIFIED EXTERNALLY specified user.
Validation	**SELECT value** **FROM v$parameter** **WHERE name = 'os_authent_prefix';**
Finding	Set to OPS$ and OPS$ externally identified user accounts have been found in the database.
Action	**We recommend that this parameter be changed and that all externally authenticated user accounts be backed up and then dropped.** **ALTER SYSTEM SET os_authent_prefix=""** COMMENT='Set to FALSE <date>' SID='*' **SCOPE=SPFILE;** The database must be restarted for this change to take effect.

OS_ROLES (1:2)

- Determines whether Oracle or the O/S identifies and manages the roles of each username
- Range of values: {FALSE | TRUE}
- The default is FALSE which means that Oracle manages the roles (not the operating system)

- Recommendation
  - CIS recommends the default value of FALSE

```
ALTER SYSTEM SET os_roles = FALSE
COMMENT='Reset to FALSE on 21-APR-2016'
SID='*'
SCOPE=SPFILE;
```

OS_ROLES (2:2)

Explanation	Set the initialization parameter os_roles to FALSE. OS_ROLES allows externally created groups to be used to manage database roles. This can lead to misaligned or inherited permissions.

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'os_roles';`

Finding	Set to FALSE
Action	No action required.

REMOTE_LISTENER (1:2)

- Specifies whether Oracle checks for a password file
  Range of values: {NULL string | <remote_listener_mapping>}
- The default is a NULL string

- Recommendation
  - CIS recommends a NULL string to prevent the use of a listener on a remote server

```
-- if an entry exists that needs to be deleted
ALTER SYSTEM RESET remote_listener
SID='*'
SCOPE=SPFILE;
```

REMOTE_LISTENER (2:2)

Explanation	Set the initialization parameter remote_listener to a NULL string. Prevent the use of a listener on a remote server separate from the database instance.

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'remote_listener';`

Action	`ALTER SYSTEM SET remote_listener="<rac_node>"`
	`COMMENT='Set to NULL <date>'`
	`SID='*'`
	`SCOPE=SPFILE;`
	
	The database must be restarted for this change to take effect.

Finding	The PROD value is:
	`*.remote_listener='prod.hr-prod.nor.???.edu:1521'`
	The QA value is:
	`*.remote_listener='norhr-prd-scan.???.net.???.edu:13444'`
	
	If there is no compelling reason for this port to be used recommend that the port number be dropped below 9000 so as not to conflict with the default database port range of 9000 to 65,000.

REMOTE_LOGIN_PASSWORDFILE (1:2)

- Specifies whether Oracle checks for a password file
  Range of values: {SHARED | EXCLUSIVE | NONE}
- The default is 'EXCLUSIVE' which means the password file is not shared among multiple DBs

- Recommendation
  - CIS recommends NONE which means that privileged users must be authenticated by the operating system

```
ALTER SYSTEM SET remote_login_passwordfile = NONE
COMMENT='Set to NONE on 21-APR-2016'
SID='*'
SCOPE=SPFILE;
```

REMOTE_LOGIN_PASSWORDFILE (2:2)

Explanation	Prevents remote privileged connections to the database. This suggests that remote administration should be performed by remotely logging into the database server via a secured connection. Alternately, an administrative listener could be created, the remote_login_passwordfile set to exclusive, and logging of the administrative listener implemented. The return value should be 'NONE' .

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'remote_login_passwordfile';`

Finding	`VALUE`
	`--------------------`
	`EXCLUSIVE`

Action	Set remote_login_passwordfile setting to none. Implement SSH or other secure shell method to remotely administer the Oracle server.
	
	`ALTER SYSTEM SET remote_login_passwordfile = 'NONE'`
	`COMMENT='Changed to NONE <date>'`
	`SID='*'`
	`SCOPE=SPFILE;`
	
	The database must be restarted for this change to take effect.

REMOTE_OS_ROLES (1:2)

- Specifies whether operating system roles are allowed for remote clients
- Range of values: {FALSE | TRUE}
- The default is FALSE which causes Oracle to identify and manage roles for remote clients

- Recommendation
  - CIS recommends the default value of FALSE

```
ALTER SYSTEM SET remote_os_roles = TRUE
COMMENT='Reset to TRUE on 21-APR-2016'
SID='*'
SCOPE=BOTH;
```

REMOTE_OS_ROLES (2:2)

Explanation	Set the initialization parameter remote_os_roles to FALSE. Connection spoofing must be prevented. The default value is FALSE.

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'remote_os_roles';`

Finding	Set to FALSE
Action	No action required.

SEC_CASE_SENSITIVE_LOGON

- Specifies that all user passwords be stored and evaluated for case sensitivity
- Range of Values: {FALSE | TRUE}
- The default is TRUE

- Recommendation
  - CIS recommends case sensitive passwords be enabled

```
ALTER SYSTEM SET sec_case_sensitive_logon = TRUE
COMMENT='Reset to TRUE on 21-APR-2016'
SID='*'
SCOPE=BOTH;
```

SEC_MAX_FAILED_LOGIN_ATTEMPTS (1:2)

- Specifies the number of authentication attempts that can be made by a client on a connection to the server process
- After the specified number of failure attempts, the connection will be automatically dropped by the server process
- The default is 10 which is a laughably high value

- Recommendation
  - CIS recommends 3

```
ALTER SYSTEM SET sec_max_failed_login_attempts = 3
COMMENT='Reset to TRUE on 21-APR-2016'
SID='*'
SCOPE=BOTH;
```

SEC_MAX_FAILED_LOGIN_ATTEMPTS (2:2)

Explanation	Set the maximum number of failed login attempts to be 3 or in sync with established password policies. This will reduce the effectiveness of a password brute force attack.

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'sec_max_failed_login_attempts';`
	
	The return value should be TRUE

Finding	`VALUE`
	`--------------------`
	`10`

Action	**Recommend setting to a lower number to minimize the footprint for a brute-force attack.**
	
	`ALTER SYSTEM SET sec_max_failed_login_attempts = 3`
	`COMMENT='Set to TRUE <date>'`
	`SID='*'`
	`SCOPE=BOTH;`
	
	The database must be restarted for this change to take effect.

SEC_PROTOCOL_ERROR_FURTHER_ACTION (1:2)

- Specifies the further execution of a server process when receiving bad packets from a possibly malicious client
- Range of Values: {CONTINUE | DELAY <integer> | DROP <integer>}
- The default is 'DROP, 3' in 12.1 but in earlier versions was CONTINUE

- Recommendation
  - CIS recommends not using CONTINUE and Oracle adopted the change in 12c

```
ALTER SYSTEM SET sec_protocol_error_trace_action = 'DELAY'
COMMENT='Set to DELAY on 21-APR-2016'
SID='*'
SCOPE=BOTH;
```

SEC_PROTOCOL_ERROR_FURTHER_ACTION (2:2)

Explanation	When bad packets are received from a client the server will wait the specified number of seconds before allowing a connection from the same client. This help mitigate malicious connections or DOS conditions. Set to DELAY <seconds>.

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'sec_protocol_error_further_action';`

Finding	`VALUE`
	`---------`
	`CONTINUE`

Action	`ALTER SYSTEM SET sec_protocol_error_further_action = 'DELAY 1'`
	`COMMENT='Set to Delay of 1 second <date>'`
	`SID='*'`
	`SCOPE=SPFILE;`
	
	The database must be restarted for this change to take effect.

SEC_PROTOCOL_ERROR_TRACE_ACTION (1:2)

- Specifies the action that the database should take when bad packets are received from a possibly malicious client
- Range of Values: {NONE | TRACE | LOG | ALERT}
- The default is 'TRACE' which causes a detailed trace file is generated when bad packets are received, which can be used to debug any problems in client/server communication

- Recommendation
  - CIS recommends not using TRACE as detailed logging can be utilized as a DDOS attack

```
ALTER SYSTEM SET sec_protocol_error_trace_action = 'ALERT'
COMMENT='Set to ALERT on 21-APR-2016'
COMMENT='Set to LOG <date>'
SID='*'
SCOPE=BOTH;
```

SEC_PROTOCOL_ERROR_TRACE_ACTION (2:2)

Explanation	Specify the action a database should take when a bad packet is received. TRACE generates a detailed trace file and should only be used when debugging. ALERT or LOG should be used to capture the event. Use currently established procedures for checking console or log file data to monitor these events.
Validation	**SELECT value** **FROM v$parameter** **WHERE name = 'sec_protocol_error_trace_action';** The return value should be LOG or ALERT
Finding	VALUE ---------- TRACE
Action	**ALTER SYSTEM SET sec_protocol_error_trace_action = 'ALERT'** **COMMENT='Set to LOG <date>'** **SID='*'** **SCOPE=BOTH;**

SEC_RETURN_SERVER_RELEASE_BANNER (1:2)

- Specifies whether or not the server returns complete database software information to clients
- Range of values: {FALSE | TRUE}
- The default is FALSE

- Recommendation
  - The parameter no longer appears to do anything and can be ignored but keep it FALSE in in view of the possibility of Oracle making changes

```
ALTER SYSTEM SET sec_return_server_release_banner = TRUE
COMMENT='Set to TRUE on 21-APR-2016'
SID='*'
SCOPE=MEMORY;

ALTER SYSTEM SET sec_return_server_release_banner = FALSE
COMMENT='Reset to FALSE on 21-APR-2016'
SID='*'
SCOPE=MEMORY;
```

SEC_RETURN_SERVER_RELEASE_BANNER (2:2)

```
-- startup with parameter set to TRUE
C:\Users\oracle>sqlplus uwclass/uwclass@pdbdev

SQL*Plus: Release 12.1.0.2.0 Production on Tue Apr 19 07:32:15 2016

Copyright (c) 1982, 2014, Oracle.  All rights reserved.

Last Successful login time: Tue Apr 19 2016 07:32:04 -07:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing options
```

```
-- startup with parameter set to FALSE
C:\Users\oracle>sqlplus uwclass/uwclass@pdbdev

SQL*Plus: Release 12.1.0.2.0 Production on Tue Apr 19 07:37:18 2016

Copyright (c) 1982, 2014, Oracle.  All rights reserved.

Last Successful login time: Tue Apr 19 2016 07:32:15 -07:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing options
```

SQL92_SECURITY

- The SQL standard specifies that security administrators should be able to require that users have SELECT privilege on a table when executing an UPDATE or DELETE statement that references table column values in a WHERE or SET clause
- SQL92_SECURITY specifies whether users must have been granted the SELECT object privilege in order to execute such UPDATE or DELETE statements
- Range of values: {FALSE | TRUE}
- The default is FALSE

- Recommendation
  - Enabling this decreases security as it grants the ability to see what is being updated or deleted as well as all other rows in the object(s)

UTL_FILE_DIR

- This parameter designates a directory path to which, without further permission grants, users can read and write data

Explanation	Remove the initialization parameter UTL_FILE_DIR and use Directory objects. Do not use the utl_file_dir parameter as the locations can be read and written to by all users. Specify directories using CREATE DIRECTORY which requires granting of privileges to each user. This function has been deprecated since version 9.2 migration is recommended.

Validation	`SELECT value`
	`FROM v$parameter`
	`WHERE name = 'utl_file_dir';`

Finding	Set in PRD and QA to: `*.utl_file_dir='/backup/fileio'` This parameter should be removed and a directory object created in its place.

Action	`ALTER SYSTEM SET utl_file_dir=''`
	`COMMENT='Set to FALSE <date>'`
	`SID='*'`
	`SCOPE=SPFILE;`
	
	The database must be restarted for this change to take effect.
	
	Use CREATE DIRECTORY to create corresponding directory object(s) as required.

Now Let's Talks About What Is Hiding In Plain Site

User Creation

Application Access

- At major Oracle customers (unnamed due to NDA) there are two types of users
  - human: a sentient human will user this user-id to log on
  - mechid: an application or application server will use this user-id to log on
- All application schemas should be created with a mechid
- Application schemas should be granted the privileges required to create objects then
  - Lock the schema and expire the password
  - Audit attempts to log onto the application schema directly (not through a proxy)
  - Revoke all SYSTEM privileges from the application schema

```
SQL> ALTER USER ps ACCOUNT LOCK;
SQL> REVOKE create session FROM ps;
SQL> REVOKE create table FROM ps;
SQL> REVOKE create procedure FROM ps;
SQL> REVOKE create view FROM ps;
SQL> ... enable auditing
```

Proxy Users (1:3)

- Here's what the Oracle docs say about proxy users: They are not wrong but incomplete and misleading

> **About Proxy Authentication**
>
> Proxy authentication is the process of using a middle-tier for user authentication. You can design a middle-tier server to proxy clients in a secure fashion by using the following three forms of proxy authentication:

  - The source of the above statement is the "Database JDBC Developer's Guide

- Here's what Tom Kyte wrote ...

> **and we said...**
>
> a proxy user is a user that is allowed to "connect on behalf of another user"
>
> say you have a middle tier application. You want to use a connection pool. You need to use a single user for that. Say that user is "midtier"
>
> Scott can grant connect through to this midtier user.

Proxy Users (2:3)

- ... and proxy users cannot be spoofed

So now the midtier user (which has just "create session" and "connect through to scott") authenticates to the database and sets up the connection pool. This midtier user is just a regular user -- anything you can do to scott, you can do to midtier, but it generally isn't relevant. For the only thing midtier will do in the database is connect really!

So, scott comes along and convinces the midtier "i am really scott". The midtier then says to the database "you know me, I'm midtier and I'd like to pretend to be scott for a while". the database looks and says "yes midtier, you are allowed to be scott for a while -- go ahead". At this point -- that midtier connection will have a session where by "select user from dual" will return SCOTT -- not midtier.

Scott never gave the midtier his password to the database, in fact, scott might not even KNOW what his password to the database it!

Now, this SCOTT session that was created on behalf of the midtier connection is subject to all of the rules and privs around the user SCOTT -- it can only do what scott is allowed to do.

The nice thing about this is:

o you have auditing back, the database knows who is using it. no more of this "single username" junk.

o you have grants back, you don't have to reinvent security over and over and over.

o you have identity preserved all of the way from the browser through the middle tier and into the database.

Proxy Users (3:3)

```
-- create a non-human database user
SQL> CREATE USER mechid
  2  IDENTIFIED BY "A1Ac9C81292FC1CF0b8A40#5F04C0A"
  3  DEFAULT TABLESPACE uwdata
  4  TEMPORARY TABLESPACE temp
  5  QUOTA 100M ON uwdata;

User created.

SQL> ALTER USER mechid ACCOUNT LOCK;

Grant succeeded.

SQL> AUDIT CONNECT BY scott ON BEHALF OF mechid;

Audit succeeded.

-- create proxy for mechid
SQL> ALTER USER mechid GRANT CONNECT THROUGH scott;

User altered.

SQL> SELECT * FROM sys.proxy_info$;

   CLIENT#     PROXY# CREDENTIAL_TYPE#      FLAGS
---------- ---------- ---------------- ----------
       142        109                0          5
```

```
SQL> conn scott[MECHID]/tiger@pdbdev
Connected.

SQL> sho user
USER is "MECHID"

SQL> SELECT sys_context('USERENV', 'CURRENT_SCHEMA')
  2  FROM dual;

SYS_CONTEXT('USERENV','CURRENT_SCHEMA')
--------------------------------------------------
MECHID

SQL> SELECT sys_context('USERENV', 'CURRENT_USER')
  2  FROM dual;

SYS_CONTEXT('USERENV','CURRENT_USER')
--------------------------------------------------
MECHID

SQL> SELECT sys_context('USERENV', 'PROXY_USER')
  2  FROM dual;

SYS_CONTEXT('USERENV','PROXY_USER')
--------------------------------------------------
SCOTT
```

User Authentication and Permissions

- No user should be created using the default profile ... more about profiles next
- Check for default password usage
  - If you find default passwords being used either change the passwords or lock and expire the account
- Do not use externally authenticated users such as OPS$ unless you can prove that O/S access is secure and will stay that way: Never with Windows

```
SQL> SELECT d.con_id, d.username, u.account_status
  2  FROM cdb_users_with_defpwd d, cdb_users u
  3  WHERE d.username = u.username
  4  AND u.account_status = 'OPEN'
  5  ORDER BY 3,1, 2;

    CON_ID USERNAME                       ACCOUNT_STATUS
---------- ------------------------------ --------------
         1 SYS                            OPEN
         1 SYS                            OPEN
         1 SYSTEM                         OPEN
         1 SYSTEM                         OPEN
         3 HR                             OPEN
         3 OE                             OPEN
         3 PM                             OPEN
         3 SCOTT                          OPEN
         3 SH                             OPEN
         3 SYS                            OPEN
         3 SYS                            OPEN
         3 SYSTEM                         OPEN
         3 SYSTEM                         OPEN
```

Profiles (1:6)

- Hardly anyone ever creates profiles and Oracle's default profile is of little value
- Look specifically at the security attributes of the profiles in use
  - PASSWORD_LIFE_TIME
  - PASSWORD_GRACE_TIME
  - PASSWORD_REUSE_TIME
  - PASSWORD_REUSE_MAX
  - FAILED_LOGIN_ATTEMPTS
  - PASSWORD_LOCK_TIME
  - PASSWORD_VERIFY_FUNCTION

```
SQL> SELECT UNIQUE profile, con_id
  2  FROM cdb_profiles
  3* ORDER BY 2,1;

PROFILE                        CON_ID
------------------------------ ----------
C##GGADMIN                              1
DEFAULT                                 1
ORA_STIG_PROFILE                        1
C##GGADMIN                              3
DEFAULT                                 3
GGADMIN                                 3
GG_PROFILE                              3
ORA_STIG_PROFILE                        3
```

Profiles (2:6)

password_life_time restricts the password lifetime will help deter brute force attacks against user accounts and refresh passwords.

password_reuse_max sets the number of different passwords that must be rotated by the user before the current password can be reused. This prevents users from cycling through a few common passwords and helps ensure the integrity and strength of user credentials.

password_reuse_time sets the amount of time that must pass before a password can be reused. Creating a long window before password reuse helps protect from password brute force attacks and helps the strength and integrity of the user credential.

password_lock_time specifies the amount of time in days that the account will be locked out if the maximum number of authentication attempts has been reached.

password_grace_time specified in days the amount of time that the user is warned to change their password before their password expires.

Profiles (3:6)

Explanation	Restricting the number of login attempts will help deter brute force attacks.

Validation	`SELECT profile, resource_name, limit`
	`FROM dba_profiles`
	`WHERE resource_type = 'PASSWORD'`
	`ORDER BY 1,2;`

Finding	PROFILE RESOURCE_NAME LIMIT ---------- ---------- ---------- DEFAULT FAILED_LOGIN_ATTEMPTS 10 DEFAULT PASSWORD_GRACE_TIME 7 DEFAULT PASSWORD_LIFE_TIME UNLIMITED DEFAULT PASSWORD_LOCK_TIME 1 DEFAULT PASSWORD_REUSE_MAX UNLIMITED DEFAULT PASSWORD_REUSE_TIME UNLIMITED DEFAULT PASSWORD_VERIFY_FUNCTION NULL MONITORING_PROFILE FAILED_LOGIN_ATTEMPTS UNLIMITED MONITORING_PROFILE PASSWORD_GRACE_TIME DEFAULT MONITORING_PROFILE PASSWORD_LIFE_TIME DEFAULT MONITORING_PROFILE PASSWORD_LOCK_TIME DEFAULT MONITORING_PROFILE PASSWORD_REUSE_MAX DEFAULT MONITORING_PROFILE PASSWORD_REUSE_TIME DEFAULT MONITORING_PROFILE PASSWORD_VERIFY_FUNCTION DEFAULT
Action	Recommend creating multiple profiles each with function appropriate limits.

Profiles (4:6)

- $ORACLE_HOME/rdbms/admin/utlpwdmg.sql

CREATE OR REPLACE FUNCTION ora12c_verify_function

```
Rem
Rem $Header: rdbms/admin/utlpwdmg.sql /main/9 2013/11/07 08:58:18 jkati Exp $
Rem
Rem utlpwdmg.sql
Rem
Rem Copyright (c) 2006, 2013, Oracle and/or its affiliates.
Rem All rights reserved.
Rem
Rem    NAME
Rem      utlpwdmg.sql - script for Default Password Resource Limits
Rem
Rem    DESCRIPTION
Rem      This is a script for enabling the password management features
Rem      by setting the default password resource limits.
Rem
Rem    NOTES
Rem      This file contains a function for minimum checking of password
Rem      complexity. This is more of a sample function that the customer
Rem      can use to develop the function for actual complexity checks that the
Rem      customer wants to make on the new password.
Rem
Rem    MODIFIED    (MM/DD/YY)
Rem    jkati        10/16/13 - bug#17543726 : remove complexity_check,
Rem                            string_distance, ora12c_strong_verify_function
Rem                            since we now provide them by default with new db
Rem                            creation
```

Profiles (5:6)

- Oracle 12c's Default profile

```
-- This script alters the default parameters for Password Management
-- This means that all the users on the system have Password Management
-- enabled and set to the following values unless another profile is
-- created with parameter values set to different value or UNLIMITED
-- is created and assigned to the user.

ALTER PROFILE DEFAULT LIMIT
PASSWORD_LIFE_TIME 180
PASSWORD_GRACE_TIME 7
PASSWORD_REUSE_TIME UNLIMITED
PASSWORD_REUSE_MAX  UNLIMITED
FAILED_LOGIN_ATTEMPTS 10
PASSWORD_LOCK_TIME 1
PASSWORD_VERIFY_FUNCTION ora12c_verify_function;
```

Profiles (6:6)

- Note that the following part of the script is commented out … not what I would want if I was responsible for database security

```
/**
The below set of password profile parameters would take into consideration
recommendations from Center for Internet Security[CIS Oracle 11g].

ALTER PROFILE DEFAULT LIMIT
PASSWORD_LIFE_TIME 90
PASSWORD_GRACE_TIME 3
PASSWORD_REUSE_TIME 365
PASSWORD_REUSE_MAX  20
FAILED_LOGIN_ATTEMPTS 3
PASSWORD_LOCK_TIME 1
PASSWORD_VERIFY_FUNCTION ora12c_verify_function;
*/

/**
The below set of password profile parameters would take into
consideration recommendations from Department of Defense Database
Security Technical Implementation Guide[STIG v8R1].

ALTER PROFILE DEFAULT LIMIT
PASSWORD_LIFE_TIME 60
PASSWORD_REUSE_TIME 365
PASSWORD_REUSE_MAX  5
FAILED_LOGIN_ATTEMPTS 3
PASSWORD_VERIFY_FUNCTION ora12c_strong_verify_function;
*/
```

Roles (1:3)

- The rule is simple ... never grant roles with excess privileges
- No user should ever be granted the following roles
  - CONNECT ... does nothing ... instead grant CREATE SESSION
  - RESOURCE ... excessive untargeted privileges
  - DBA ... excessive untargeted privileges by any rational definition
- Internally defined roles should be hierarchical and based on job function

```
CREATE ROLE read_only;

CREATE ROLE ap_clerk;
GRANT read_only TO ap_clerk;
GRANT select ON general_ledger TO ap_clerk;
GRANT insert ON ap_master TO ap_clerk;
GRANT update ON ap_master TO ap_clerk;
GRANT insert ON ap_detail TO ap_clerk;
GRANT update ON ap_detail TO ap_clerk;

CREATE ROLE ap_manager IDENTIFIED BY appwd;
GRANT ap_clerk TO ap_manager;
GRANT delete ON ap_master TO ap_manager;
GRANT delete ON ap_detail TO ap_manager;
GRANT select any table TO ap_manager;
```

Roles (2:3)

- ADMINISTER KEY MANAGEMENT
- ALTER ANY CUBE BUILD PROCESS
- ALTER ANY MEASURE FOLDER
- ALTER ANY SQL TRANSLATION PROFILE
- CREATE ANY CREDENTIAL
- CREATE ANY SQL TRANSLATION PROFILE
- CREATE CREDENTIAL
- CREATE PLUGGABLE DATABASE
- CREATE SQL TRANSLATION PROFILE
- DROP ANY SQL TRANSLATION PROFILE
- EM EXPRESS CONNECT
- EXEMPT ACCESS POLICY
- EXEMPT DDL REDACTION POLICY
- EXEMPT DML REDACTION POLICY
- EXEMPT IDENTITY POLICY
- EXEMPT REDACTION POLICY
- INHERIT ANY PRIVILEGES
- KEEP_DATE TIME
- KEEP_SYSGUID
- LOGMINING
- PURGE DBA_RECYCLEBIN
- REDEFINE ANY TABLE
- SELECT ANY CUBE BUILD PROCESS
- SELECT ANY MEASURE FOLDER
- SET CONTAINER
- SYSBACKUP
- SYSDG
- SYSKM
- TRANSLATE ANY SQL
- USE ANY SQL TRANSLATION PROFILE

Roles (3:3)

- Roles can be further protected through passwords and PL/SQL package validation

```
-- role secured by password
CREATE ROLE read_only IDENTIFIED BY "S0^Sorry";

-- role secured by PL/SQL package
CREATE OR REPLACE PACKAGE db_security AUTHID CURRENT_USER IS
  PROCEDURE enable_role;
END db_security;
/

CREATE OR REPLACE PACKAGE BODY db_security IS
  PROCEDURE enable_role IS
  BEGIN
    dbms_session.set_role('read_only');
  END enable_role;
END db_security;
/

SELECT * FROM dba_application_roles;

CREATE ROLE read_only IDENTIFIED USING db_security;
```

  - A PL/SQL package can perform numerous tests to identify the user and their connection before granting access
  - If the package object returns an exception the role is not granted

System Privileges (1:2)

- The rule is simple ... never grant privileges in excess of those required to perform a specified job function
- Don't grant "ANY" privileges without documented justification
- Oracle 12c has 6 new system privileges
- If you have not done so in the last 12 months review all users for their system privileges and revoke those not required
  - AUDIT_ADMIN
  - AUDIT_VIEWER
  - CAPTURE_ADMIN
  - CDB_DBA
  - DBA
  - OPTIMIZER_PROCESSING_RATE
  - PDB_DBA
- There is literally no excuse for granting Oracle's DBA role to any user
  - No one should have privileges they don't need and don't know what they do

System Privileges (2:2)

```
SQL> select privilege
  2  FROM dba_sys_privs
  3  WHERE grantee = 'DBA'
  4  ORDER BY 1;

PRIVILEGE
----------------------------------
-------
ADMINISTER ANY SQL TUNING SET
ADMINISTER DATABASE TRIGGER
ADMINISTER RESOURCE MANAGER
ADMINISTER SQL MANAGEMENT OBJECT
ADMINISTER SQL TUNING SET
ADVISOR
ALTER ANY ASSEMBLY
ALTER ANY CLUSTER
ALTER ANY CUBE
ALTER ANY CUBE BUILD PROCESS
ALTER ANY CUBE DIMENSION
ALTER ANY DIMENSION
ALTER ANY EDITION
ALTER ANY EVALUATION CONTEXT
ALTER ANY INDEX
ALTER ANY INDEXTYPE
ALTER ANY LIBRARY
ALTER ANY MATERIALIZED VIEW
ALTER ANY MEASURE FOLDER
ALTER ANY MINING MODEL
ALTER ANY OPERATOR
ALTER ANY OUTLINE
ALTER ANY PROCEDURE
ALTER ANY ROLE
ALTER ANY RULE
ALTER ANY RULE SET
ALTER ANY SEQUENCE
ALTER ANY SQL PROFILE
ALTER ANY SQL TRANSLATION PROFILE
ALTER ANY TABLE
ALTER ANY TRIGGER
ALTER ANY TYPE
ALTER DATABASE
ALTER PROFILE
ALTER RESOURCE COST
ALTER ROLLBACK SEGMENT
ALTER SESSION
ALTER SYSTEM
ALTER TABLESPACE
ALTER USER
ANALYZE ANY
ANALYZE ANY DICTIONARY
AUDIT ANY
AUDIT SYSTEM
BACKUP ANY TABLE
BECOME USER
CHANGE NOTIFICATION
COMMENT ANY MINING MODEL
COMMENT ANY TABLE
CREATE ANY ASSEMBLY
CREATE ANY CLUSTER
CREATE ANY CONTEXT
CREATE ANY CREDENTIAL
CREATE ANY CUBE
CREATE ANY CUBE BUILD PROCESS
CREATE ANY CUBE DIMENSION
CREATE ANY DIMENSION
CREATE ANY DIRECTORY
CREATE ANY EDITION
CREATE ANY EVALUATION CONTEXT
CREATE ANY INDEX
CREATE ANY INDEXTYPE
CREATE ANY JOB
CREATE ANY LIBRARY
CREATE ANY MATERIALIZED VIEW
CREATE ANY MEASURE FOLDER
CREATE ANY MINING MODEL
CREATE ANY OPERATOR
CREATE ANY OUTLINE
CREATE ANY PROCEDURE
CREATE ANY RULE
CREATE ANY RULE SET
CREATE ANY SEQUENCE
CREATE ANY SQL PROFILE
CREATE ANY SQL TRANSLATION
PROFILE
CREATE ANY SYNONYM
CREATE ANY TABLE
CREATE ANY TRIGGER
CREATE ANY TYPE
CREATE ANY VIEW
CREATE ASSEMBLY
CREATE CLUSTER
CREATE CREDENTIAL
CREATE CUBE
CREATE CUBE BUILD PROCESS
CREATE CUBE DIMENSION
CREATE DATABASE LINK
CREATE DIMENSION
CREATE EVALUATION CONTEXT
CREATE EXTERNAL JOB
CREATE INDEXTYPE
CREATE JOB
CREATE LIBRARY
CREATE MATERIALIZED VIEW
CREATE MEASURE FOLDER
CREATE MINING MODEL
CREATE OPERATOR
CREATE PLUGGABLE DATABASE
CREATE PROCEDURE
CREATE PROFILE
CREATE PUBLIC DATABASE LINK
CREATE PUBLIC SYNONYM
CREATE ROLE
CREATE ROLLBACK SEGMENT
CREATE RULE
CREATE RULE SET
CREATE SEQUENCE
CREATE SESSION
CREATE SQL TRANSLATION PROFILE
CREATE SYNONYM
CREATE TABLE
CREATE TABLESPACE
CREATE TRIGGER
CREATE TYPE
CREATE USER
CREATE VIEW
DEBUG ANY PROCEDURE
DEBUG CONNECT SESSION
DELETE ANY CUBE DIMENSION
DELETE ANY MEASURE FOLDER
DELETE ANY TABLE
DEQUEUE ANY QUEUE
DROP ANY ASSEMBLY
DROP ANY CLUSTER
DROP ANY CONTEXT
DROP ANY CUBE
DROP ANY CUBE BUILD PROCESS
DROP ANY CUBE DIMENSION
DROP ANY DIMENSION
DROP ANY DIRECTORY
DROP ANY EDITION
DROP ANY EVALUATION CONTEXT
DROP ANY INDEX
DROP ANY INDEXTYPE
DROP ANY LIBRARY
DROP ANY MATERIALIZED VIEW
DROP ANY MEASURE FOLDER
DROP ANY MINING MODEL
DROP ANY OPERATOR
DROP ANY OUTLINE
DROP ANY PROCEDURE
DROP ANY ROLE
DROP ANY RULE
DROP ANY RULE SET
DROP ANY SEQUENCE
DROP ANY SQL PROFILE
DROP ANY SQL TRANSLATION PROFILE
DROP ANY SYNONYM
DROP ANY TABLE
DROP ANY TRIGGER
DROP ANY TYPE
DROP ANY VIEW
DROP PROFILE
DROP PUBLIC DATABASE LINK
DROP PUBLIC SYNONYM
DROP ROLLBACK SEGMENT
DROP TABLESPACE
DROP USER
EM EXPRESS CONNECT
ENQUEUE ANY QUEUE
EXECUTE ANY ASSEMBLY
EXECUTE ANY CLASS
EXECUTE ANY EVALUATION CONTEXT
EXECUTE ANY INDEXTYPE
EXECUTE ANY LIBRARY
EXECUTE ANY OPERATOR
EXECUTE ANY PROCEDURE
EXECUTE ANY PROGRAM
EXECUTE ANY RULE
EXECUTE ANY RULE SET
EXECUTE ANY TYPE
EXECUTE ASSEMBLY
EXEMPT DDL REDACTION POLICY
EXEMPT DML REDACTION POLICY
EXPORT FULL DATABASE
FLASHBACK ANY TABLE
FLASHBACK ARCHIVE ADMINISTER
FORCE ANY TRANSACTION
FORCE TRANSACTION
GLOBAL QUERY REWRITE
GRANT ANY OBJECT PRIVILEGE
GRANT ANY PRIVILEGE
GRANT ANY ROLE
IMPORT FULL DATABASE
INSERT ANY CUBE DIMENSION
INSERT ANY MEASURE FOLDER
INSERT ANY TABLE
LOCK ANY TABLE
LOGMINING
MANAGE ANY FILE GROUP
MANAGE ANY QUEUE
MANAGE FILE GROUP
MANAGE SCHEDULER
MANAGE TABLESPACE
MERGE ANY VIEW
ON COMMIT REFRESH
QUERY REWRITE
READ ANY FILE GROUP
READ ANY TABLE
READ ANY TABLE
REDEFINE ANY TABLE
RESTRICTED SESSION
RESUMABLE
SELECT ANY CUBE
SELECT ANY CUBE BUILD PROCESS
SELECT ANY CUBE DIMENSION
SELECT ANY DICTIONARY
SELECT ANY MEASURE FOLDER
SELECT ANY MINING MODEL
SELECT ANY SEQUENCE
SELECT ANY TABLE
SELECT ANY TRANSACTION
SET CONTAINER
UNDER ANY TABLE
UNDER ANY TYPE
UNDER ANY VIEW
UPDATE ANY CUBE
UPDATE ANY CUBE BUILD PROCESS
UPDATE ANY CUBE DIMENSION
UPDATE ANY TABLE
USE ANY SQL TRANSLATION PROFILE

220 rows selected.
```

THINK YOU "NEED" THE DBA ROLE?

FEEL FREE TO EXPLAIN WHY YOU NEED THE READ ANY TABLE PRIVILEGE

Object Privileges

- The rule is simple ... never grant privileges to objects that are not required
- If granting access to a table you have choices
  - SELECT
  - INSERT
  - UPDATE
  - DELETE
- If granting update privileges control by column whenever possible

```
GRANT UPDATE (first_name, last_name) ON person TO uwclass;
```

- No data has ever been stolen because the privileges were too granular

V$ Object Access (1:2)

- Anyone that can query Oracle X$ and/or V$ objects can bypass the vast majority of Oracle Database security
- Some of the objects that are critically important to protect are
  - V_$MAPPED_SQL
  - V_$SQL
  - V_$SQLAREA
  - V_$SQLAREA_PLAN_HASH
  - V_$SQLSTATS
  - V_$SQLSTATS_PLAN_HASH
  - V_$SQLTEXT
  - V_$SQLTEXT_WITH_NEWLINES
  - V_$SQL_BIND_CAPTURE
  - V_$SQL_BIND_DATA
  - V_$SQL_OPTIMIZER_ENV
  - V_$SQL_PLAN

V$ Object Access (2:2)

- If data is not encrypted before DML the original statement can be recovered
- Transparent Data Encryption (TDE) offers no protection from this attack

```
SQL> CREATE TABLE credit_card (
  2  ccno  VARCHAR2(19),
  3  cname VARCHAR2(25));

Table created.

SQL> INSERT /* memtest */ INTO credit_card
  2  VALUES ('5123-4567-8901-2345', 'Dan Morgan');

1 row created.

SQL> SELECT sql_id, sql_fulltext
  2  FROM v$sqlarea
  3  WHERE sql_fulltext LIKE '%memtest%';

SQL_ID        SQL_FULLTEXT
------------- --------------------------------------------------------------------------------
fy44ug06np5w4 INSERT /* memtest */ INTO credit_card
              VALUES ('5123-4567-8901-2345', 'Dan Morgan')

5d4p3uz59b0a1 SELECT sql_id, sql_fulltext♂FROM v$sqlarea♂WHERE sql_fulltext LIKE '%memtest3%'
```

Product User Profile

- Product User Profile has existed in the Oracle Database since at least ver 6
- It is staggeringly powerful and it should be enabled in every Oracle database

```
SQL> INSERT INTO system.product_user_profile
  2  (product, userid, attribute, scope, numeric_value, char_value, date_value, long_value)
  3  VALUES
  4  ('SQL*Plus', 'SCOTT', 'SELECT', NULL, NULL, 'DISABLED', NULL, NULL);

1 row created.

SQL> commit;

Commit complete.

SQL> DELETE FROM system.product_user_profile
  2  WHERE userid = 'SCOTT';

1 row deleted.

SQL> commit;

Commit complete.
```

```
SQL> desc product_user_profile
Name                 Null?    Type
-------------------- -------- -------------
PRODUCT              NOT NULL VARCHAR2(30)
USERID                        VARCHAR2(30)
ATTRIBUTE                     VARCHAR2(240)
SCOPE                         VARCHAR2(240)
NUMERIC_VALUE                 NUMBER(15,2)
CHAR_VALUE                    VARCHAR2(240)
DATE_VALUE                    DATE
LONG_VALUE                    LONG
```

Database Communications

Database Communications

- The Oracle database has multiple built-in technologies to facilitate communication with the file system, with other databases, with applications, and directly with the internet
- Secure communications involves all of the following steps
  - Preventing access to unauthorized databases via database links
  - Preventing unauthorized communications with external procedures
  - Preventing unauthorized access to file systems
  - Preventing unauthorized access to internal networks and external networks
  - Preventing unauthorized email communications
- Every item listed above, every demo in this section, is part of Oracle's default licensing

Database Link Communications (1:2)

- Database Links can be a valuable productivity tool
- They can also be an attack vector
- Regularly audit existing links and creation of new links

Explanation	Database links are objects that allow creation of an almost transparent connection between databases that can be used to select, insert, update, and/or delete data.

Validation	`SELECT *`
	`FROM dba_db_links`
	`ORDER BY 1,2;`

Finding	

```
OWNER      DB_LINK                      USERNAME  HOST    CREATED
---------- ---------------------------- --------- ------- ---------
PUBLIC     EPMPRD.???.EDU               SYSADM    EPMPRD  19-APR-12
PUBLIC     FINPRD.???.EDU               SYSADM    FINPRD  10-NOV-11
PUBLIC     HRRPT.???.EDU                SYSADM    HRRPT   10-NOV-11
PUBLIC     HRTRN.???.EDU                SYSADM    HRTRN   10-NOV-11
PUBLIC     OEPRD.???.EDU                PS_READ   oeprd   07-DEC-11
PUBLIC     OUDWH.???.EDU                PS_READ   ??DWH   10-NOV-11
PUBLIC     OUPRD.???.EDU                PS_READ   ??PRD   10-NOV-11
PUBLIC     PROD.???.EDU                 PS_READ   PROD    10-NOV-11
SPOTLIGHT  QUEST_SOO_HRPRD1.???.EDU               hrprd1  02-DEC-11
SPOTLIGHT  QUEST_SOO_HRPRD2.???.EDU               hrprd2  02-DEC-11
SPOTLIGHT  QUEST_SOO_HRPRD3.???.EDU               hrprd3  02-DEC-11
```

Database Link Communications (2:2)

- DBMS_DISTRIBUTED_TRUST_ADMIN
  - First released with in 2001, contains procedures to maintain the Trusted Servers List
  - Use the package to define whether a server is trusted. If a database is not trusted, Oracle refuses current user database links from the database
    - Cannot stop PDB to PDB links in the same CDB

```
SQL> exec dbms_distributed_trust_admin.deny_all;

PL/SQL procedure successfully completed.

SQL> SELECT * FROM ku$_trlink_view;

V V NAME                           FUNCTION                                      TYPE
- - ------------------------------ ---------------------------------------- ----------
1 0 -*                             DBMS_DISTRIBUTED_TRUST_ADMIN.DENY_ALL            0

SQL> exec dbms_distributed_trust_admin.allow_server('BIGDOG.MLIB.ORG');

PL/SQL procedure successfully completed.

SQL> SELECT * FROM ku$_trlink_view;

V V NAME                           FUNCTION                                      TYPE
- - ------------------------------ ---------------------------------------- ----------
1 0 -*                             DBMS_DISTRIBUTED_TRUST_ADMIN.DENY_ALL            0
1 0 BIGDOG.MLIB.ORG                DBMS_DISTRIBUTED_TRUST_ADMIN.ALLOW_SERVER        1
```

External Procedure Communications (1:2)

- DBMS_CREDENTIAL
  - First released in 12cR1 credentials are database objects that hold a username/password pair for authenticating and impersonating
    - EXTPROC callout functions
    - Remote jobs
    - External jobs
    - DBMS_SCHEDULER file watchers
  - Credentials are created using the CREATE_CREDENTIAL procedure in the built-in package
  - The package allows specifying the Windows domain for remote external jobs executed against a Windows server

```
SQL> SELECT DISTINCT grantee, table_name AS OBJECT_NAME, privilege
  2  FROM cdb_tab_privs
  3  WHERE table_name IN ('DBMS_CREDENTIAL')
  4  AND grantee = 'PUBLIC';

GRANTEE  OBJECT_NAME        PRIVILEGE
-------- ------------------ -----------
PUBLIC   DBMS_CREDENTIAL       EXECUTE
```

External Procedure Communications (2:2)

- DBMS_CREDENTIAL

```
DECLARE
 cname    user_credentials.credential_name%TYPE := 'UWCRED';
 uname    user_credentials.username%TYPE := 'UWCLASS';
 pwd      sys.scheduler$_credential.password%TYPE := 'ZzYzX6*';
 dbrole   VARCHAR2(30) := NULL;
 windom   sys.scheduler$_credential.domain%TYPE := NULL;
 comment user_credentials.comments%TYPE := 'Test Cred';
 enable   BOOLEAN := FALSE;
BEGIN
  dbms_credential.create_credential(cname, uname, pwd, dbrole, windom, comment, enable);
END;
/

SELECT * FROM scheduler$_credential;
```

File System Access (1:5)

- The Oracle database contains a number of built-in components that can be utilized to enable reading and writing to file systems
  - Secure data can be written
  - External files can be read
- Some have execute granted to PUBLIC and the public privileges should be revoked
- What you need to secure is
  - DBMS_ADVISOR
  - DBMS_LOB
  - DBMS_SQL
  - DBMS_XSLPROCESSOR
  - UTL_FILE

- Does this look like security by default?

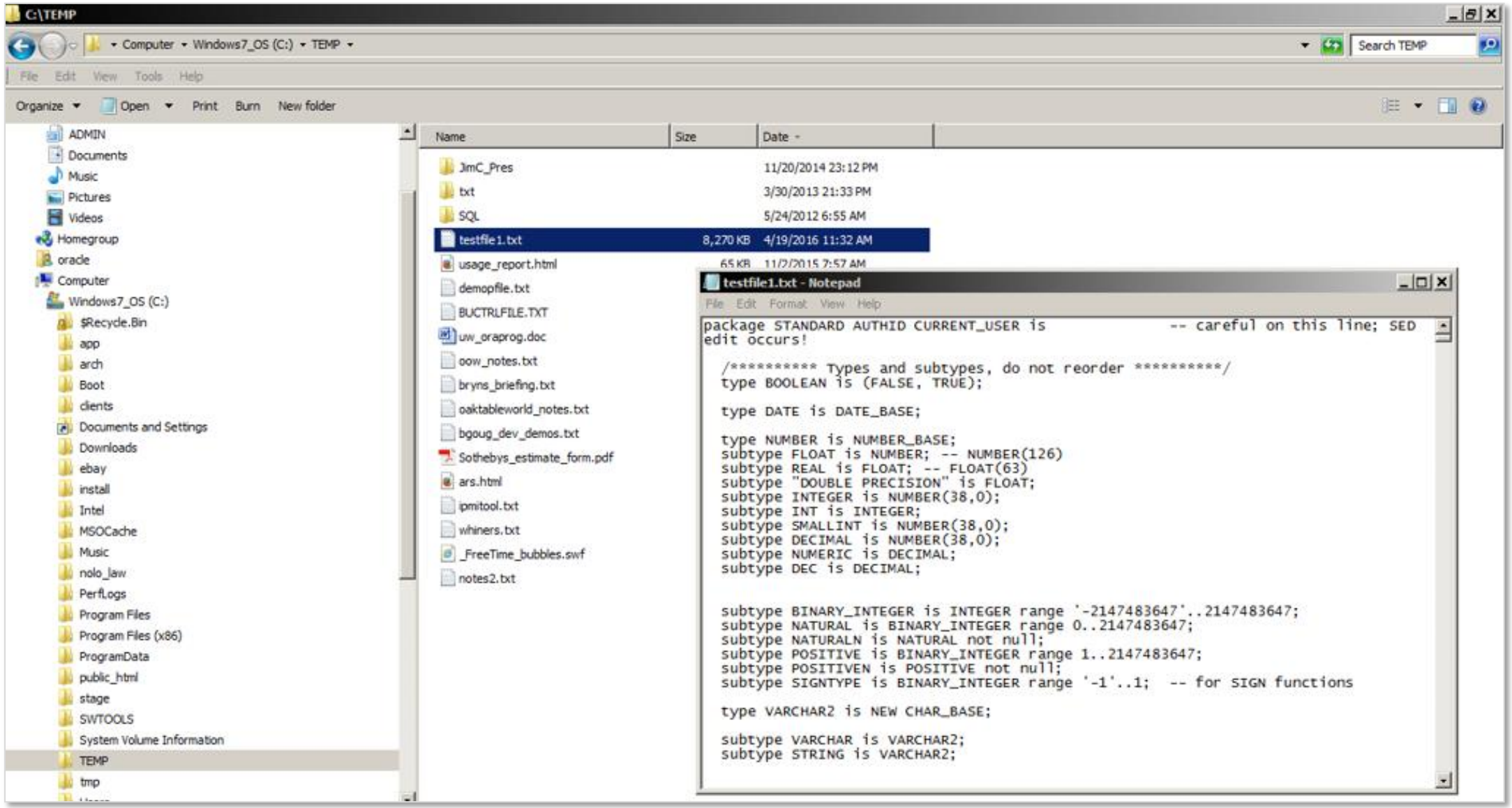
```
SQL> SELECT DISTINCT grantee, table_name AS OBJECT_NAME, privilege
  2  FROM cdb_tab_privs
  3  WHERE table_name IN ('DBMS_ADVISOR',
                          'DBMS_LOB',
                          'DBMS_SCHEDULER'
                          'DBMS_SQL',
                          'DBMS_XSLPROCESSOR',
                          'UTL_FILE')
  4  AND grantee = 'PUBLIC'
  5* ORDER BY 2;

GRANTEE  OBJECT_NAME         PRIVILEGE
-------- ------------------- -----------
PUBLIC   DBMS_ADVISOR        EXECUTE
PUBLIC   DBMS_LOB            EXECUTE
PUBLIC   DBMS_SCHEDULER      EXECUTE
PUBLIC   DBMS_SQL            EXECUTE
PUBLIC   DBMS_XSLPROCESSOR   EXECUTE
PUBLIC   UTL_FILE            EXECUTE
```

File System Access (2:5)

```
SQL> conn uwclass/uwclass@pdbdev
Connected.

SQL> CREATE TABLE uwclass.t (
  2  textcol CLOB);

Table created.

SQL>
SQL> DECLARE
  2   c CLOB;
  3   CURSOR scur IS
  4   SELECT text
  5   FROM dba_source
  6   WHERE rownum < 200001;
  7  BEGIN
  8    EXECUTE IMMEDIATE 'truncate table uwclass.t';
  9    FOR srec IN scur LOOP
 10     c := c || srec.text;
 11   END LOOP;
 12   INSERT INTO uwclass.t VALUES (c);
 13   COMMIT;
 14  END;
 15  /

PL/SQL procedure successfully completed.

SQL> SELECT LENGTH(textcol) FROM uwclass.t;

LENGTH(TEXTCOL)
---------------
        8258936
```

```
SQL> set timing on
SQL> DECLARE
  2   buf CLOB;
  3  BEGIN
  4    SELECT textcol
  5    INTO buf
  6    FROM uwclass.t
  7    WHERE rownum = 1;
  8
  9    dbms_advisor.create_file(buf, 'CTEMP', 'testfile1.txt');
 10  END;
 11  /

PL/SQL procedure successfully completed.

Elapsed: 00:00:00.61
```

File System Access (3:5)



File System Access (4:5)

- EXTERNAL TABLES
  - The CREATE TABLE privilege grants the privilege to create external tables
  - Does this make you feel secure?
  - Maybe you don't have a directory object pointing to $ADR_HOME/trace but what directory objects exist in your database by default?

```
CREATE OR REPLACE DIRECTORY bdump AS 'c:\app\oracle\diag\rdbms\orabase\orabase\trace\';

CREATE TABLE log_table (TEXT VARCHAR2(400))
ORGANIZATION EXTERNAL (
TYPE oracle_loader
DEFAULT DIRECTORY bdump
ACCESS PARAMETERS (
  RECORDS DELIMITED BY NEWLINE
  NOBADFILE NODISCARDFILE NOLOGFILE
  FIELDS TERMINATED BY '0x0A'
  MISSING FIELD VALUES ARE NULL)
LOCATION ('alert_orabase.log'))
REJECT LIMIT unlimited;

SELECT * FROM log_table;
```

Carefully monitor use of the CREATE ANY DIRECTORY privilege

File System Access (5:5)

- DBMS_SCHEDULER
  - First available in version 10gR1 file watchers became available with version 11gR2
  - A File Watcher is a program that watches for a file to be created

```
-- create job credential
exec dbms_scheduler.create_credential('uw_credential', 'uwclass', 'uwclass');

-- create program in disabled state
exec dbms_scheduler.create_program('file_watcher', 'stored_procedure', 'load_file', 1);

 -- define program argument
exec dbms_scheduler.define_metadata_argument('file_watcher', 'EVENT_MESSAGE', 1);

-- enable program
exec dbms_scheduler.enable('file_watcher');

-- create file watcher
exec dbms_scheduler.create_file_watcher('UW_FWatch', 'STAGE', 'democlob.txt', 'uw_credential');
```

Network Communications (1:5)

- The Oracle database contains a number of built-in components that can be utilized to enable communications to the intranet and internet
- Configure access control lists with DBMS_NETWORK_ACL_ADMIN and do not grant privileges to the following packages without strict controls
  - DBMS_NETWORK_ACL_ADMIN
  - DBMS_NETWORK_ACL_UTILITY
  - UTL_HTTP
  - UTL_INADDR
  - UTL_MAIL
  - UTL_SMTP
  - UTL_TCP

- Does this look like security by default?

```
SQL> SELECT grantee, table_name
  2  FROM cdb_tab_privs
  3  WHERE table_name IN ('DBMS_NETWORK_ACL_ADMIN',
                          'DBMS_NETWORK_ACL_UTILITY',
                          'UTL_HTTP',
                          'UTL_INADDR',
                          'UTL_MAIL',
                          'UTL_SMTP',
                          'UTL_TCP')
  4  ORDER BY 2,1;

GRANTEE                 TABLE_NAME
----------------------- -----------
APEX_040200             UTL_HTTP
DBA                     DBMS_NETWORK_ACL_ADMIN
EXECUTE_CATALOG_ROLE    DBMS_NETWORK_ACL_ADMIN
PUBLIC                  DBMS_NETWORK_ACL_UTILITY
ORDPLUGINS              UTL_HTTP
PUBLIC                  UTL_HTTP
ORACLE_OCM              UTL_INADDR
PUBLIC                  UTL_INADDR
APEX_040200             UTL_SMTP
PUBLIC                  UTL_SMTP
PUBLIC                  UTL_TCP
```

Network Communications (2:5)

- UTL_INADDR Demo

```
SQL> SELECT utl_inaddr.get_host_address('www.oracle.com')
  2  FROM dual;

UTL_INADDR.GET_HOST_ADDRESS('WWW.ORACLE.COM')
------------------------------------------------------------
2600:1407:10:38a::2d3e

SQL> SELECT utl_inaddr.get_host_name('10.27.192.131') FROM dual;

UTL_INADDR.GET_HOST_NAME('10.27.192.131')
------------------------------------------------------------
norhr-prd1.bigu.net.zz.edu

SQL> SELECT utl_inaddr.get_host_name('10.241.1.0') FROM dual;

UTL_INADDR.GET_HOST_NAME('10.241.1.0')
------------------------------------------------------------
network-10-241-1-0.ps-db.nor.zzint

SQL> SELECT utl_inaddr.get_host_address('norhr-prd1.sooner.net.ou.edu')
FROM dual;

UTL_INADDR.GET_HOST_ADDRESS('NORHR-PRD1.BIGU.NET.ZZ.EDU')
------------------------------------------------------------
10.36.192.131
```

Network Communications (3:5)

- DBMS_NETWORK_ACL_ADMIN/UTILITY

```
SQL>  SELECT utl_inaddr.get_host_name('10.241.1.71') FROM dual;
 SELECT utl_inaddr.get_host_name('10.241.1.71') FROM dual
        *
ERROR at line 1:
ORA-24247: network access denied by access control list (ACL)
ORA-06512: at "SYS.UTL_INADDR", line 4
ORA-06512: at "SYS.UTL_INADDR", line 35
ORA-06512: at line 1
```

Network Communications (4:5)

- DBMS_NETWORK_ACL_ADMIN/UTILITY Demo

```
SQL> SELECT DECODE(
  2    dbms_network_acl_admin.check_privilege('mlib-org-permissions.xml',
  3    'UWCLASS', 'connect'), 1, 'GRANTED', 0, 'DENIED', NULL) PRIVILEGE
  4  FROM DUAL;
  dbms_network_acl_admin.check_privilege('mlib-org-permissions.xml',
  *
ERROR at line 2:
ORA-46114: ACL name /sys/acls/mlib-org-permissions.xml not found.

SQL> BEGIN
  2    dbms_network_acl_admin.create_acl(acl => 'mlib-org-permissions.xml',
  3    description => 'Network permissions for *.morganslibrary.org',
  4    principal => 'UWCLASS', is_grant => TRUE, privilege => 'connect');
  5  END;
  6  /

PL/SQL procedure successfully completed.

SQL> SELECT DECODE(
  2    dbms_network_acl_admin.check_privilege('mlib-org-permissions.xml',
  3    'UWCLASS', 'connect'), 1, 'GRANTED', 0, 'DENIED', NULL) PRIVILEGE
  4  FROM DUAL;

PRIVILEGE
----------
GRANTED
```

Network Communications (5:5)

- UTL_HTTP Demo

```
DECLARE
 req   utl_http.req;
 resp  utl_http.resp;
 value VARCHAR2(1024);
BEGIN
  req := utl_http.begin_request('http://www.morganslibrary.org');
  utl_http.set_header(req, 'User-Agent', 'Mozilla/4.0');
  resp := utl_http.get_response(req);
  LOOP
    utl_http.read_line(resp, value, TRUE);
    dbms_output.put_line(value);
  END LOOP;
  utl_http.end_response(resp);
EXCEPTION
  WHEN utl_http.end_of_body THEN
    utl_http.end_response(resp);
END;
/
```

Securing Data

Encryption (1:2)

- In the database you can implement many different types of encryption: Each one optimized for a specific purpose some of which require extra licensing such as TDE and SecureFiles
- DBMS_CRYPTO
- STANDARD_HASH

```
SQL> DECLARE
  2   enc_val   RAW(2000);
  3   l_key     RAW(2000);
  4   l_key_len NUMBER := 128/8; -- convert bits to bytes
  5   l_mod     NUMBER := dbms_crypto.ENCRYPT_AES128+dbms_crypto.CHAIN_CBC+dbms_crypto.PAD_ZERO;
  6  BEGIN
  7    l_key := dbms_crypto.randombytes(l_key_len);
  8    enc_val := dbms_crypto.encrypt(utl_i18n.string_to_raw('4114-0113-1518-7114', 'AL32UTF8'), l_mod, l_key);
  9    dbms_output.put_line(enc_val);
 10  END;
 11  /
3DBA29959C45EE0E54B5BE6F2304BC1CFB2FFACA2D44A43A2C1E071E2ACA98D7

PL/SQL procedure successfully completed.
```

Encryption (2:2)

- In the database you can implement many different types of encryption: Each one optimized for a specific purpose some of which require extra licensing such as TDE and SecureFiles
- DBMS_CRYPTO
- STANDARD_HASH

```
SQL> SELECT STANDARD_HASH('Morgan', 'SHA1') FROM dual;

STANDARD_HASH('MORGAN','SHA1')
----------------------------------------
8E4408B475D63385A73AED2FE911DD9818E82FB5

SQL> SELECT STANDARD_HASH('Morgan', 'SHA256') FROM dual;

STANDARD_HASH('MORGAN','SHA256')
----------------------------------------------------------------
02281B3B5DD57C4643681B8B113C9D56E9B8F1DC8C30A5BBA4C864BDD27D1ED7

SQL> SELECT STANDARD_HASH('Morgan', 'SHA384') FROM dual;

STANDARD_HASH('MORGAN','SHA384')
----------------------------------------------------------------
D0739D820F3D82ED347EF68626FD6E08DC918CA98DEA41587C213ABEDACA7C25A4
6712D6E36D79857D775EC4A4CD9586

SQL> SELECT STANDARD_HASH('Morgan', 'SHA512') FROM dual;

STANDARD_HASH('MORGAN','SHA512')
----------------------------------------------------------------
1E7C57248F1F665BCB46F6CB4FDF4765E1D6C533D4BAA360089FD30530CE82543E
CCDB7A0526AEED0F637DBA147DC52DE41823179ECABCF5BBA8D0CE97EEB34F
```

Recyclebin

- Tables contain data and when tables are dropped, unless the PURGE keyword is used, the table and its indexes remain queryable and recoverable in the recyclebin
- Always drop table with PURGE
  `drop table <table_name> PURGE;`

```
SQL> CREATE TABLE dropme (soc_sec_no VARCHAR2(11));

SQL> INSERT INTO dropme (soc_sec_no)
  2  VALUES ('523-14-0963');

SQL> COMMIT;

SQL> DROP TABLE dropme;

SQL> SELECT object_name, original_name, type, related, base_object
  2  FROM user_recyclebin;

SQL> SELECT * FROM "BIN$eVwc/lghQwq9QkrmYD1vRg==$0";

SQL> FLASHBACK TABLE dropme TO BEFORE DROP;

SQL> desc dropme

SQL> SELECT * FROM dropme;
```

SQL Injection (1:4)

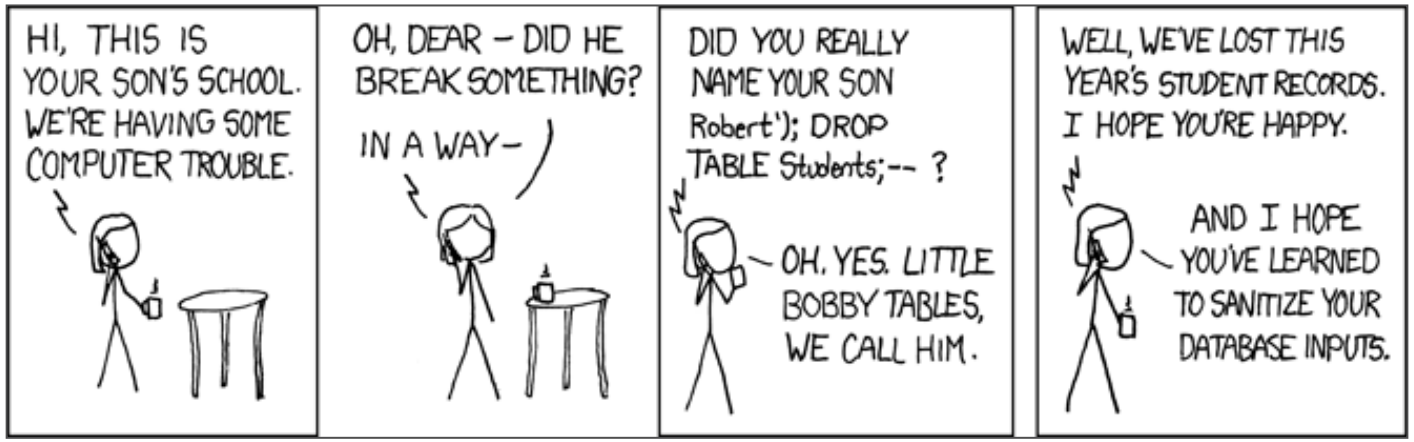
- 25% of all attacks are by SQL Injection ... and 89% of all data stolen is the result of SQL Injection attacks
- If you do not know how to attack your databases ... how can you prevent an attack?
- There are essentially three things you need to know to protect your data and your job
  - Bind Variables
  - DBMS_ASSERT
  - Sanitize Inputs

SQL Injection (2:4)

- Bind Variables

```
-- not using bind variables: SQL injection
SQL> Accept Uname prompt "Enter username: "
Enter username: Tom Kyte

SQL> Accept Pword prompt "Enter pass: "
Enter pass: i_dont_know ' or 'x ' ='x

-- using bind variables
SELECT COUNT(*)
FROM user_table
WHERE username = '&Uname'
AND password = '&Pword';
```

- Sanitizing Inputs
  - If a picture is worth a thousand words a cartoon is worth ten-thousand



xkcd.com

SQL Injection (3:4)

- A large percentage of successful SQL Injection attacks combine a user interface with dynamic SQL (NDS or DBMS_SQL) and a failure to keep up with Oracle's efforts to stop these attacks
- The DBMS_ASSERT package provides an interface to validate properties of an input value and can prevent the overwhelming majority of attacks from being successful
- Built-in functions
  - ENQUOTE_LITERAL
  - ENQUOTE_NAME
  - NOOP
  - QUALIFIED_SQL_NAME
  - SCHEMA_NAME
  - SIMPLE_SQL_NAME
  - SQL_OBJECT_NAME

```
SQL> SELECT dbms_assert.sql_object_name('UWCLASS.SERVERS')
  2  FROM dual;

DBMS_ASSERT.SQL_OBJECT_NAME('UWCLASS.SERVERS')
------------------------------------------------------------
UWCLASS.SERVERS

SQL> SELECT dbms_assert.sql_object_name('UWCLASS.SERVERZ')
  2  FROM dual;
SELECT dbms_assert.sql_object_name('UWCLASS.SERVERZ')
       *
ERROR at line 1:
ORA-44002: invalid object name
ORA-06512: at "SYS.DBMS_ASSERT", line 383
```

SQL Injection (4:4)

Validation

```
SELECT owner, name, line, text
FROM dba_source
WHERE LOWER(text) LIKE '%dbms_sql.%'
AND owner NOT IN ('SYS', 'SYSTEM', 'WMSYS', 'MDSYS', 'OUTLN',
'SYSMAN', 'ORACLE_OCM', 'APEX_030200', 'XDB')
UNION
SELECT owner, name, line, text
FROM dba_source
WHERE LOWER(text) LIKE '%execute immediate%'
AND owner NOT IN ('SYS', 'SYSTEM', 'WMSYS', 'MDSYS', 'OUTLN',
'SYSMAN', 'ORACLE_OCM', 'APEX_030200', 'XDB')
ORDER BY 1,2;
```

Action

Examine each PL/SQL line returned to reconstruct the full originating statement and whether usage of bind variables and/or DBMS_ASSERT will prevent a SQL Injection.

It appe
addres

```
OWNER       NAME                 LINE TEXT
----------- ------------------ ----- --------------------------------------------------------------------------
OPS$ORACLE  CK_CORRUPT              8 EXECUTE IMMEDIATE 'DECLARE idx_corrupt INT;'
OPS$ORACLE  CK_CORRUPT             36 EXECUTE IMMEDIATE    'DECLARE tbl_corrupt INT;'
OPS$ORACLE  DBA_PACK              192 EXECUTE IMMEDIATE cmd;
OPS$ORACLE  DBA_PACK              214 EXECUTE IMMEDIATE cmd;
OPS$ORACLE  DBA_PACK              223 EXECUTE IMMEDIATE cmd;
SPOTLIGHT   EXECUTE_IMMEDIATE      12 l_cursor := DBMS_SQL.OPEN_CURSOR;
SPOTLIGHT   EXECUTE_IMMEDIATE      13 DBMS_SQL.PARSE(l_cursor, p_sql_text, DBMS_SQL.NATIVE);
SPOTLIGHT   EXECUTE_IMMEDIATE      14 rc := DBMS_SQL.EXECUTE(l_cursor);
SPOTLIGHT   EXECUTE_IMMEDIATE      15 DBMS_SQL.CLOSE_CURSOR(l_cursor);
SPOTLIGHT   EXECUTE_IMMEDIATE      20 EXCEPTION WHEN COMPILATION_ERROR THEN DBMS_SQL.CLOSE_CURSOR(l_cursor);
SPOTLIGHT   EXECUTE_IMMEDIATE      23 DBMS_SQL.CLOSE_CURSOR(l_cursor);
```

Enterprise Edition Only (1:2)

- Oracle Advanced Security
  - Encryption through-out the database stack
- DB Vault
  - Protects sensitive data from access by users with privileged accounts
- Label Security
  - Fine Grained Access Control extended to finer granularity and control
- Privilege Analysis
  - Analyses assigned privileges
- Enterprise User Security
  - Integration of database user accounts with LDAP
- Redaction (formerly known as Data Masking)
  - Data transformation to protect sensitive data
- Secure External Password Store
  - Uses an Oracle Wallet to hold password credentials

Enterprise Edition Only (2:2)

- Transparent Sensitive Data Protection
  - Grouping of columns for application of data masking (redaction) policies
- Virtual Private Database (Row Level Security)
  - Uses PL/SQL functions to create a WHERE clause or append to an existing WHERE clause preventing unauthorized row level data access
- Real Application Security
  - Enables 3-tier and 2-tier applications to declaratively define, provision, and enforce their security requirement

Oracle Advanced Security (OAS)

- Only available with Enterprise Edition
- Additional licensing cost
- Required for Transparent Data Encryption (TDE) which transparently to an application encrypts data in datafiles
  - Provides no protection against any theft other than an attempt to copy physical data files
- Required for encrypting RMAN backups to disk
- Required for encrypting DataPump exports
- Required for encrypting Data Guard traffic
- Required for Transparent Data Encryption master key storage
- Required for network encryption

Database Vault

- Requires Enterprise Edition
- Requires Licensing
- Groups schemas, objects, and roles into groups named realms and protects them from access even by users with DBA-level access
- Creates PL/SQL expressions to customize database restrictions
- Defines attributes to record data such as session users or IP addresses that Database Vault can recognize and secure
- Defines secure application roles that are enabled only by Database Vault rules

Label Security (OLS)

- Requires Enterprise Edition
- Requires Licensing
- Use to secure your database tables at the row level, and assign rows different levels of security based on the row's data
- For example, rows that contain highly sensitive data can be assigned a label entitled HIGHLY SENSITIVE; rows that are less sensitive can be labeled as SENSITIVE; rows that all users can have access to can be labeled PUBLIC

```
SQL> SELECT object_type, COUNT(*)
  2  FROM dba_objects
  3  WHERE owner = 'LBACSYS'
  4  GROUP BY object_type
  5* ORDER BY 1;

OBJECT_TYPE             COUNT(*)
------------------- ----------
FUNCTION                    24
INDEX                       30
LIBRARY                     11
PACKAGE                     23
PACKAGE BODY                22
PROCEDURE                    9
SEQUENCE                     3
TABLE                       22
TRIGGER                      3
TYPE                         9
TYPE BODY                    4
VIEW                        77
```

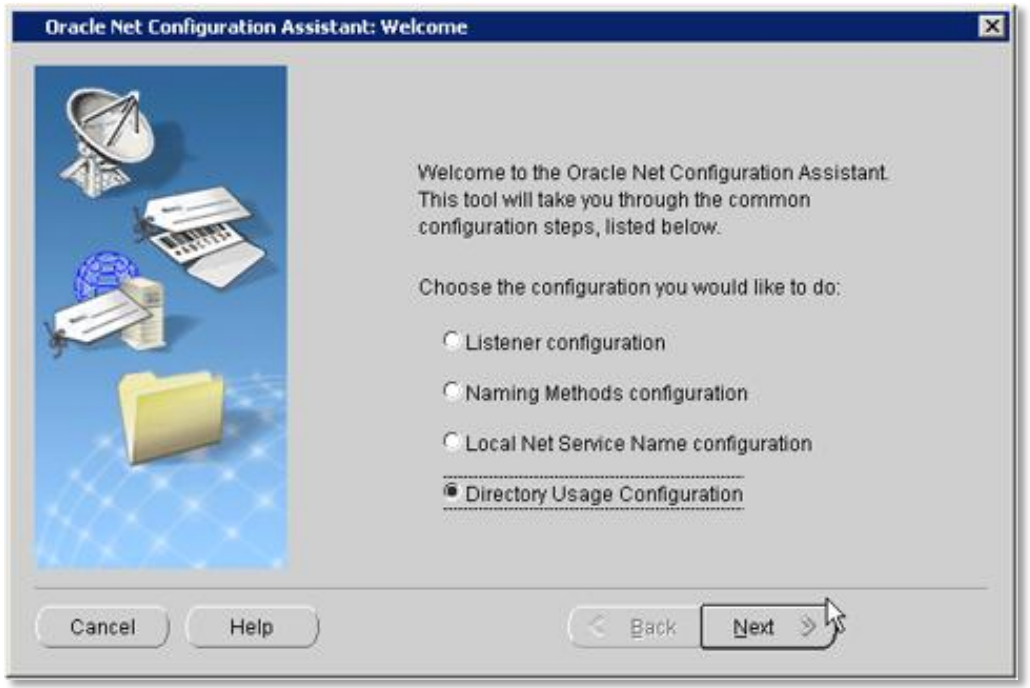
Privilege Analysis

- Requires Enterprise Edition
- Requires Database Vault license
- Implemented with the DBMS_PRIVILEGE_CAPTURE built-in package
- Contains the following objects
  - CREATE_CAPTURE
  - DISABLE_CAPTURE
  - DROP_CAPTURE
  - ENABLE_CAPTURE
  - GENERATE_RESULT

```
DECLARE
 rlist role_name_list;
BEGIN
  rlist := role_name_list(NULL);
  rlist(1) := 'CONNECT';
  rlist.extend;
  rlist(2) := 'EXECUTE_CATALOG_ROLE';

  dbms_privilege_capture.create_capture('
       UWPrivCapt',
       'Test policy',
       dbms_privilege_capture.g_role,
       rlist,
       NULL);
  dbms_privilege_capture.enable_capture('UWPrivCapt');
  dbms_privilege_capture.disable_capture('UWPrivCapt');
  dbms_privilege_capture.generate_result('UWPrivCapt');
END;
/
```

Enterprise User Security

- Requires Enterprise Edition
- Requires Licensing
- Enterprise users are those users that are defined in a directory and their identity remains constant throughout the enterprise
- Enterprise User Security relies on Oracle Identity Management infrastructure, which in turn uses an LDAP-compliant directory service to centrally store and manage users



Data Redaction (1:2)

- Requires Enterprise Edition
- Requires Licensing
- Replaces traditional data masking with more robust policy based masking capabilities with the power of regular expressions to identify sensitive data
- Based on the built-in DBMS_REDACT package

Data Redaction (2:2)

```
DECLARE
  lSchema       redaction_policies.object_owner%TYPE := USER;
  lObject       redaction_policies.object_name%TYPE := 'PERSON';
  lPolicy       redaction_policies.policy_name%TYPE := 'PERSON_SSN_REDACT';
  lDescript     redaction_policies.policy_description%TYPE := 'SSN Obfuscation';
  lColumn       redaction_columns.column_name%TYPE := 'SSN';
  lColDes       redaction_columns.column_description%TYPE := 'SSN Masking Test';
  lFuncType     BINARY_INTEGER := dbms_redact.full;
  lFuncParam    redaction_columns.function_parameters%TYPE := '';
  lExpression   VARCHAR2(60) := 'SYS_CONTEXT(''SYS_SESSION_ROLES'', ''SUPERVISOR'') = ''FALSE''';
  lEnable       BOOLEAN := FALSE;
  lREPattern    redaction_columns.regexp_pattern%TYPE := NULL;
  lReplString   redaction_columns.regexp_replace_string%TYPE := NULL;
  lREPosition   BINARY_INTEGER := 1;
  lREOccur      BINARY_INTEGER := 0;
  lREMatchParm redaction_columns.regexp_match_parameter%TYPE := NULL;
 BEGIN
   dbms_redact.add_policy(lSchema, lObject, lPolicy, lDescript, lColumn, lColDes,
                          lFuncType, lFuncParam, lExpression, lEnable, lREPattern,
                          lReplString, lREPosition, lREOccur, lREMatchParm);
 END;
 /
```

Secure External Password Store

- Requires Enterprise Edition
- Requires Licensing
- Uses an external wallet to hold database passwords

```
-- create wallet directory
mkdir $ORACLE_BASE/admin/orabase/wallet

-- modify SQLNET.ORA
NAMES.DIRECTORY_PATH = (TNSNAMES, EZCONNECT)
ENCRYPTION_WALLET_LOCATION = (SOURCE = (METHOD=FILE) (METHOD_DATA = (DIRECTORY = /u01/oracle/admin/orabase\wallet)))
```

Transparent Sensitive Data Protection (TSDP)

- Requires Enterprise Edition
- Requires Licensing
- Permits creating sets of columns with the same sensitive type (like credit card number) on the database level
- Data Redaction is used on the policies for masking sets of columns the same way across a database
- Implemented with the DBMS_TSDP_MANAGE and DBMS_TSDP_PROTECT built-in packages

```
exec dbms_tsdp_manage.add_sensitive_type('FIN_TYPE', 'Finanical Information');

SELECT * FROM dba_tsdp_policy_type;

exec dbms_tsdp_manage.add_sensitive_column('SCOTT', 'EMP', 'SAL', 'FIN_TYPE', 'Employee Salaries');

SELECT * FROM dba_tsdp_policy_protection;
```

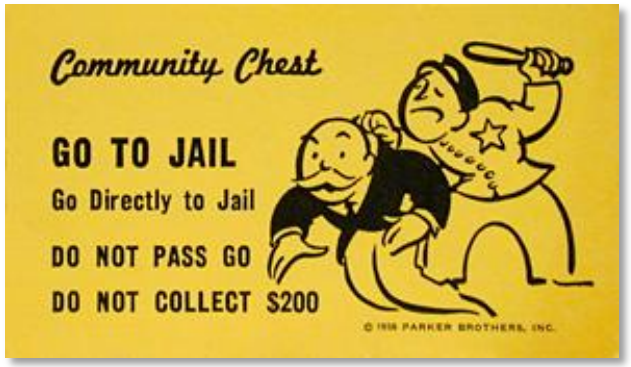
Virtual Private Database aka Row Level Security (VPD / RLS)

- Provides row-level security at the database table or view level
- Can be extended to provide column-level security as well
- Essentially, creates or modifies an existing WHERE clause rewriting a query in the optimizer so that the query cannot return restricted rows or columns
- Based on the built-in DBMS_RLS package

```
FUNCTION empview_sec(owner VARCHAR2, objname VARCHAR2) RETURN VARCHAR2 IS
  predicate VARCHAR2(2000);
BEGIN
  IF (sys_context('exp_rpt', 'exp_role') = 'manager') THEN
    predicate := 'cost_center_id = sys_context(''exp_rpt'', ''cc_number'')';
  ELSE
    predicate := 'employee_id = sys_context(''exp_rpt'', ''emp_number'')';
  END IF;
  RETURN predicate;
END empview_sec;
```

Real Application Security (RAS)

- Requires Enterprise Edition (no extra licensing required)
- Provides a declarative model that enables security policies that encompass not only the business objects being protected but also the principals (users and roles) that have permissions to operate on those business objects
- A policy-based authorization model that recognizes application-level users, privileges, and roles within the database, and then controls access on both static and dynamic collections of records representing business objects
- With built-in support for securely propagating application users' sessions to the database, Oracle RAS allows security policies on data to be expressed directly in terms of the application users, their roles and security contexts
- Can also act as an authorization decision service to assist the application in enforcing security within the middle-tier
- Creates and uses Access Control Lists (ACL) which are a collection of privilege grants or Access Control Entries (ACE), where an ACE grants or denies privileges to a user or a role


Community Chest
GO TO JAIL
Go Directly to Jail
DO NOT PASS GO
DO NOT COLLECT $200
© 1936 PARKER BROTHERS, INC.

Wrap Up

Both Of These This Train Wrecks Were Avoidable

```
DIR=/opt/oracle/scripts
. /home/oracle/.profile_db

DB_NAME=hrrpt
ORACLE_SID=$DB_NAME"1"
export ORACLE_SID

SPFILE=`more $ORACLE_HOME/dbs/init$ORACLE_SID.ora | grep -i spfile`
PFILE=$ORACLE_BASE/admin/$DB_NAME/pfile/init$ORACLE_SID.ora
LOG=$DIR/refresh_$DB_NAME.log
RMAN_LOG=$DIR/refresh_$DB_NAME"_rman".log

PRD_PWD=sys_pspr0d
PRD_SID=hrprd1
PRD_R_UNAME=rman_pshrprd
PRD_R_PWD=pspr0d11
PRD_BK=/backup/hrprd/rman_bk
SEQUENCE=`grep "input archive log thread" $PRD_BK/bk.log | tail -1 | awk '{ print $5 }'`
THREAD=`grep "input archive log thread" $PRD_BK/bk.log | tail -1 | awk '{ print $4 }'`

BK_DIR=/backup/$DB_NAME/rman_bk
EXPDIR=/backup/$DB_NAME/exp
DMPFILE=$EXPDIR/exp_sec.dmp
IMPLOG=$EXPDIR/imp_sec.log
EXPLOG=$EXPDIR/exp_sec.log
EXP_PARFILE=$DIR/exp_rpt.par
IMP_PARFILE=$DIR/imp_rpt.par

uname=rman_pshrprd
pwd=pspr0d11

rman target sys/$PRD_PWD@$PRD_SID catalog $PRD_R_UNAME/$PRD_R_PWD@catdb auxiliary / << EOF > $RMAN_LOG
  run{
     set until $SEQUENCE $THREAD;
     ALLOCATE AUXILIARY CHANNEL aux2 DEVICE TYPE DISK;
     duplicate target database to $DB_NAME;
  }
EOF
```

Conclusion

- It is difficult to dig yourself out of a hole after the sides have fallen in
- Very few organizations have employees with the skill set required to secure their databases and broader Oracle environments: Less than 1% of a DBA's "training" involves real-world security
- Security and Auditing are two entirely different things: Having one does lessen the importance of having the other
- If you think about all of the audits you have passed ... do you think that what got you passed the audit made you secure?
- The Meta7 team has database security SMEs and has performed work for the Department of Defense, major financial institutions, and values real security far more than just passing an audit


Thank you
*
ERROR at line 1:
ORA-00028: your session has been killed
Meta7

A Few Caveats (1:2)

- What is wrong with the way our industry views security is that we must secure data not software
  - Oracle is generic software
  - We build our own database structure/layout/design
  - We build our own applications (web / forms / APEX, JAVA, ...)
  - We must also build our own security
  - Security is not done well or forgotten in the rush implement features and performance
  - Our focus, for years, has been on hardening not securing
- ACCESSIBLE_BY Clause

```
*
ERROR at line 1:
ORA-00028: your session has been killed
```

Thank you