Oracle Security for DBAs and Developers

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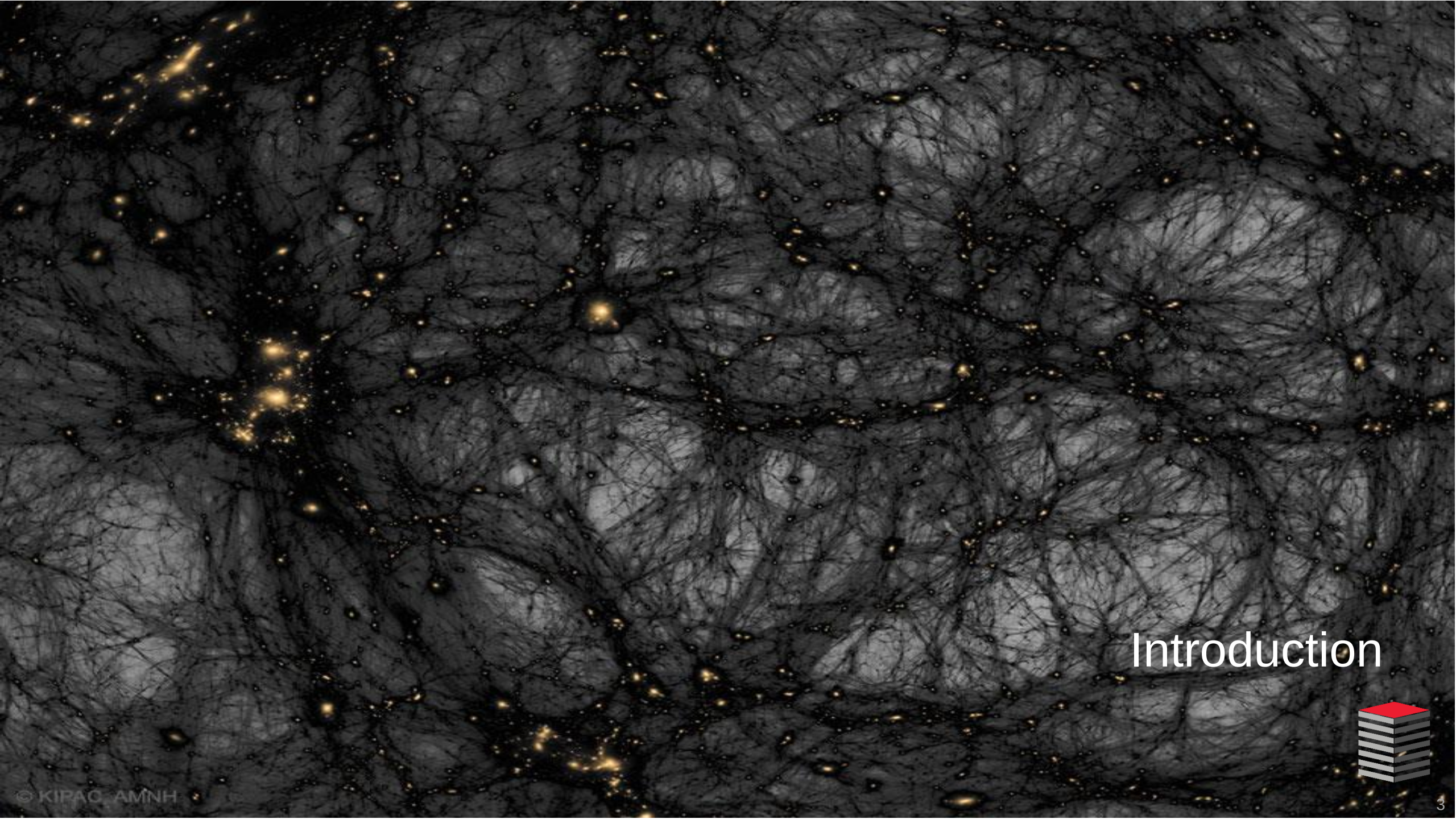
Thursday: November 16, 2017

Unsafe Harbor

- This room is an unsafe harbor
- You can rely on the information in this presentation to help you protect your data, your databases, your organization, and your career
- No one from Oracle has previewed this presentation
- No one from Oracle knows what I'm going to say
- No one from Oracle has supplied any of my materials
- Everything we will discuss is existing, proven, functionality



Introduction

Daniel Morgan

- Oracle ACE Director Alumni
- 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 Cenfotec, Universidad Latina de Panama, 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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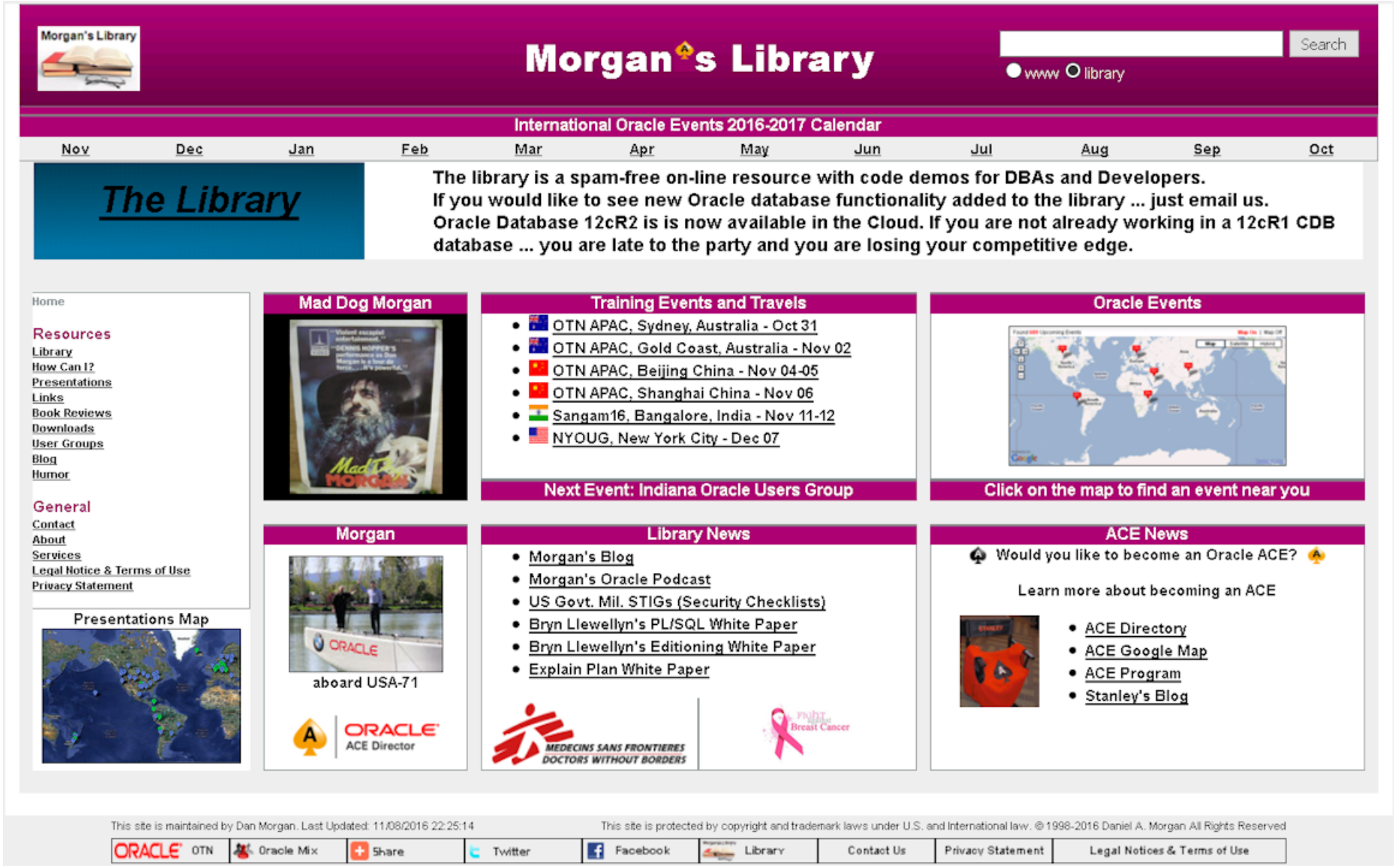
My Websites: Morgan's Library



www.morganslibrary.org`

Forsythe (1:2)

- In business 46 years
- $1.2B in 2016
- Partner with more than 200 technology OEMs

A10 Networks	DataCableTech	Liquidware Labs Logitech	Riverbed Technology
AccessData	Dataram	LockPath	RSA Security
Accutech	Dell EMC	LogLogic	SafeNet
Acronis	Dialogic Dovetailed Technologies	LogRhythm	Sanbolic
ADVA	Digital Guardian	Loop1 Systems	Seagate
Aerohive	Dynatrace	LSI Corporation	Securonix
AirMagnet	Eaton Powerware	Luminex	Server Technology
AirTight Networks	EDGE Memory	Maxell	Service Now
AirWatch	Emulex	McAfee	Silver Peak
AlgoSec	EndRun Technologies	Mellanox Technologies	Software Diversified Services
Amazon	Entrust	Microsoft	Solarflare Communications
APC	Equinix	MobileIron	SolarWinds
AppDynamics	ExtraHop	MRV	Sophos
AppSense	F5 Networks	Multi-Tech Systems	Spectra Logic
Apptio	Fidelis Cybersecurity	nCircle Network Security	Splunk
APTARE	Finisar	Net Optics	STEALTHbits Technologies
Arbor Networks	FireEye	NetApp	SUSE
Arista	FireMon	NetBrain	Symantec
Aruba Networks	Fluke Networks	NetScout	Symmetricom
Avago Technologies	ForeScout Technologies	Netskope	T5
Avant Communications	Fortinet	Network Executive Software	Tele-Communication, Inc.
Avocent Corporation	Fuji	Nimble Storage	Tenable Network Security
Axway	Fujifilm	Norman Data Defense Systems,	Texas Memory Systems
Barracuda Networks	Fujitsu	Inc.	The Written Word
BlueCat Networks	Fusion-io	Northern Software	TierPoint
BMC Software	Gemalto	Novell	Tintri
Boldon James	GIGABYTE	NTP Software	Titus
Box	Gigamon	Nutanix	TransVault
Bradford Networks	Google	NVIDIA	Trend Micro
Brocade	Guidance Software	OCZ Technology	Tripp Lite
CA Technologies	HBGary	Opengear	Tripwire
Cable-Comm Technologies	HDS	Oracle	Trustwave Holdings
Carbon Black	Hewlett Packard Enterprise	Palo Alto Networks	Tufin Software North America,
Catbird Networks	IBM	Panasonic North America	Inc.
CCX Corporation	Imation	Panduit	Variphy

Forsythe (2:2)

- In business 46 years
- $1.2B in 2016
- Partner with more than 200 technology OEMs

Centrify	Imperva	Panzura	Varonis
Cenzic	Index Engines	Peer Software	VCE
Chatsworth	Infoblox	Pivot3	Veeam
Check Point	Intel	PKWARE	Veracode
Ciena	IPsoft	Proofpoint	Veritas
Cisco	Ipswitch	Pure Storage	Vertiv
Citrix	ISI Telemanagement Solutions,	Qlogic	Viavi Solutions
Cloudgenix	Inc.	Qualys	Violin Memory
CommVault	Ixia	Quantum	Viptela
Cortelco	JadeLiquid Software	Radware	Virtual Instruments
Crossbeam Systems	JDSU	Rapid7	VMTurbo
CrowdStrike	Juniper	Raritan	VMware
CTERA Networks	Kingston	RecoveryPlanner	Voltage Security
CyberArk	Lancope	Red Hat	Vormetric
Cylance	Lantronix	RedSeal Systems	Websense
Damballa	Lenovo	Resilient, an IBM Company	Winchester Systems
	Liebert	Reveille Software	Zerto

Forbes AMERICA'S BEST MANAGEMENT CONSULTING FIRMS 2016

Forbes | 2017 AMERICA'S BEST MANAGEMENT CONSULTING FIRMS Powered by Statista

7th straight year CRN Top 50 Providers

THE CHANNEL CO. CRN SOLUTION PROVIDER 500 2017

THE CHANNEL CO. CRN TECH ELITE 250 2017

THE CHANNEL CO. CRN MSP 500 2017

- Focusing on solutions to business problems ... not products

What Meta7 Brings To The Party

ORACLE Platinum Partner

- Oracle only division of Forsythe
- Platinum Partner
- Focuses on the entire Oracle technology stack
  - The entire line of Oracle infrastructure from x86 through the full stack of engineered systems and storage
  - Oracle Database
    - Design and Deployment
    - Stability
    - Security
    - Scalability
  - Data Integration (GoldenGate and ODI)
  - Oracle Cloud
    - DevOps
    - Infrastructure as Code
- Focusing on solutions to business problems ... not products

ORACLE PARTNERNETWORK
FY16 Oracle North America Partner
Outstanding Achievement in Hardware

ORACLE PARTNERNETWORK
FY16 Oracle North America Partner
Outstanding Achievement in Engineered Systems

ORACLE PARTNERNETWORK
FY16 Oracle North America Partner
Outstanding Achievement in SMB Market - Hardware

Meta7 In Oracle Magazine (1:2)

Oracle Magazine
July – August 2017

Features
Departments
Technology & Comment Sections—
Articles and Columns

FEATURES

Great Integrations
By David Baum
Cloud-based integration reduces complexity and connects the enterprise.

Analytics for Business
By David Baum
Organizations look to the cloud to make mission-critical decisions.

Go Big, Go Metal
By Linda Currey Post
Falkonry chooses Oracle Bare Metal Cloud Services to support its pattern-recognition software.

Lessons Learned
By Jeff Erickson
Meta7 shares three top tips for moving to the cloud.

Meta7 In Oracle Magazine (2:2)

FEATURE

As Published In
ORACLE MAGAZINE
July/August 2017

Lessons Learned

By Jeff Erickson

Meta7 shares three top tips for moving to the cloud.

Meta7 knows firsthand how cloud computing is changing organizations and careers. Persistent requests from clients prompted the firm, an Oracle Platinum Partner, to purchase more than US$1.3 million worth of Oracle platform and infrastructure services to deepen its own expertise in helping customers procure and implement Oracle Cloud solutions.

Since then, the company has migrated some of its own business processes to the cloud and built many models and demos based on scenarios at clients of various sizes. "We've worked to understand everything from how a third-party on-premises application leverages Oracle Database Cloud to what's involved in a complete lift-and-shift of Oracle E-Business Suite to Oracle Cloud," says Paul Zajdel, vice president at Meta7, a division of Forsythe Technology that is dedicated to the Oracle stack.

> "All the deep-dive tuning and performance work, all the spinning up instances, the time it takes to understand how the new release handles things and explain how it's different— that's high-value, time-consuming work that DBAs don't have to do when the database is in the cloud."
>
> – *Paul Zajdel, Vice President, Meta7*

What the Meta7 team learned goes well beyond cloud service features and functions. Team members have stretched their skills with new technologies and have taken on new roles to accommodate cloud services in application architectures.

That kind of change is nothing new for Meta7 and Forsythe, which began in the early 1970s as a technology hardware leasing company. "We've reinvented ourselves several times throughout our 45-year existence," says Zajdel. It started with leasing, then reselling, then adding services, then adding security, and now adding managed services. He adds, "We're in an industry that shifts. Each time the industry shifts, we have to shift, too."

Stability: IT Fire Fighting

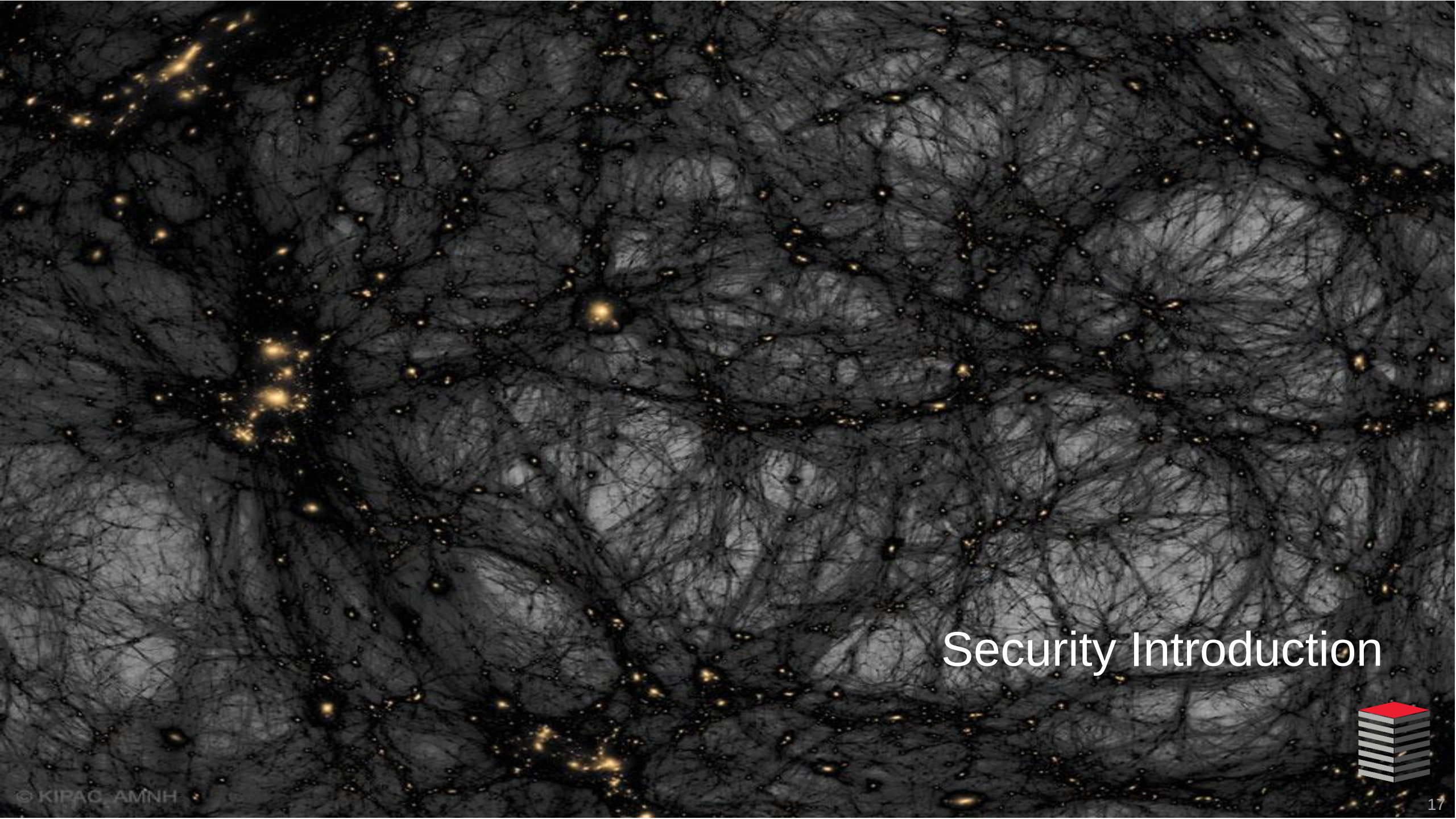

Oracle Stack Security

Scalability: VLDBs and Partitioning

Database Performance


Zero Downtime Migration

Just In Time IT Procurement


Security Introduction
© KIPAC, AMNH

Why Am I Focusing On Oracle Database Security?

- Because OEM's talk about products not security
- Because most organizations spend/waste their money on perimeter defense
- 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 is 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

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

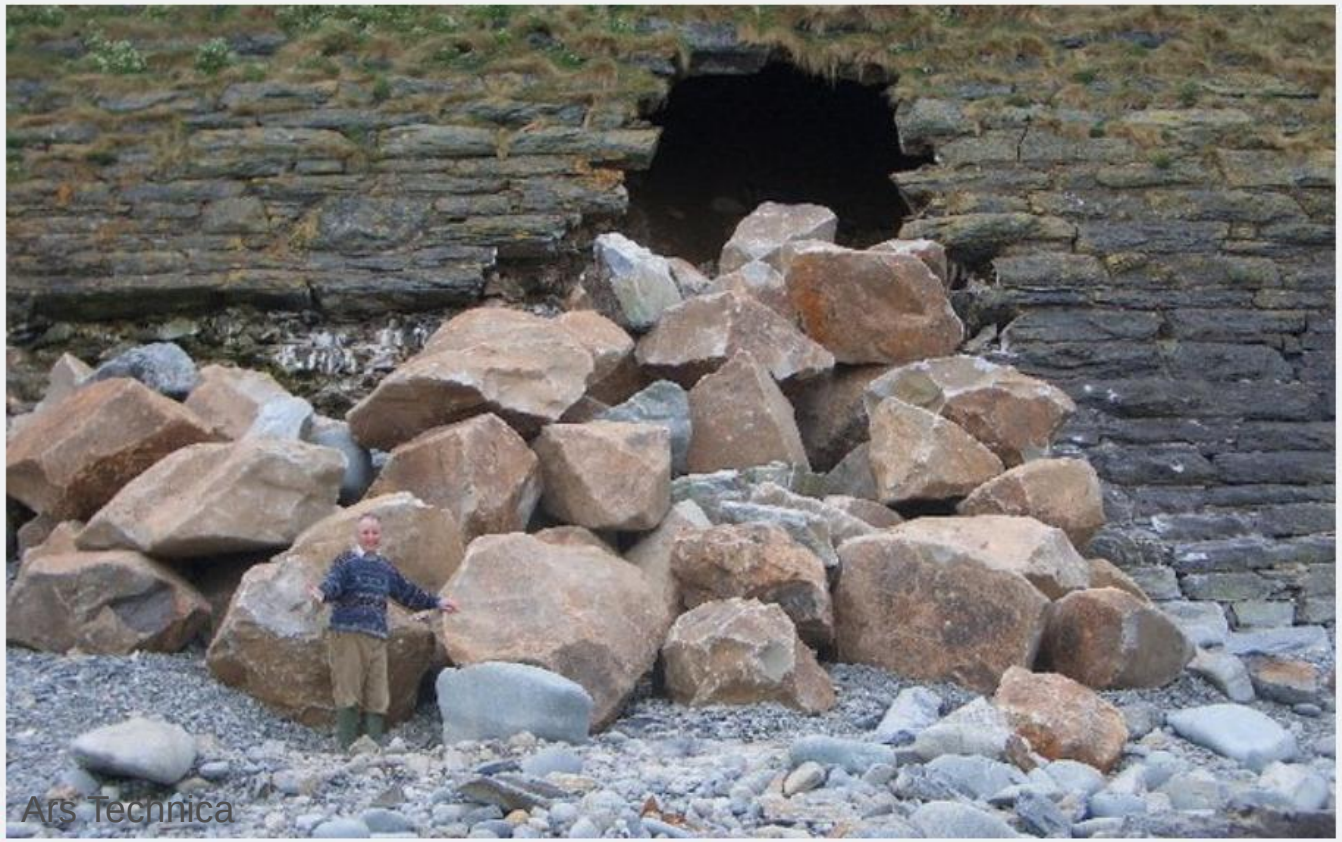
- International Accounting Standards
- Basel II (Global Banking)
- OECD Guidelines on Corporate Governance

Nothing To See Here ... Move Along ... Move Along

Breach exposes at least 58 million accounts, includes names, jobs, and more

With 2 months left, more than 2.2 billion records dumped so far in 2016.

DAN GOODIN - 10/12/2016, 2:29 PM



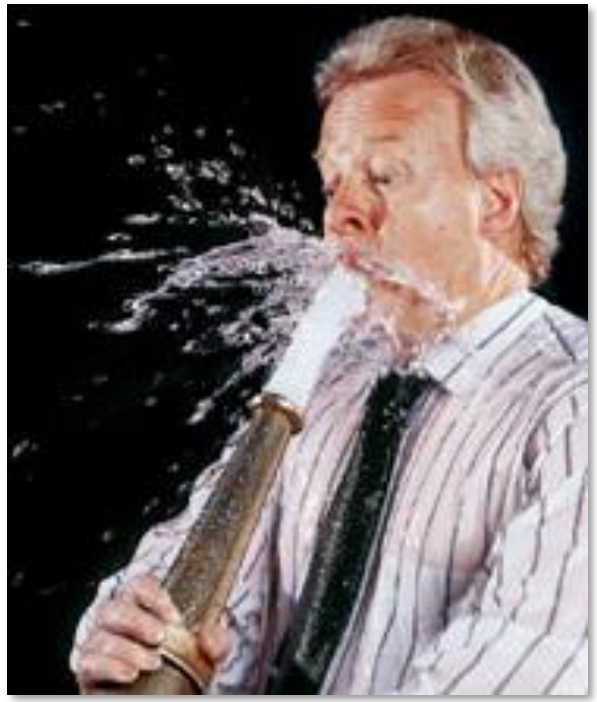
Ars Technica

Today's Rhetorical Question

- Would we want our surgeon to practice 1980s medicine?

- Then why are we "securing" our databases the way we did in the 80's?
- The threats have evolved but we have not

Content Density Warning

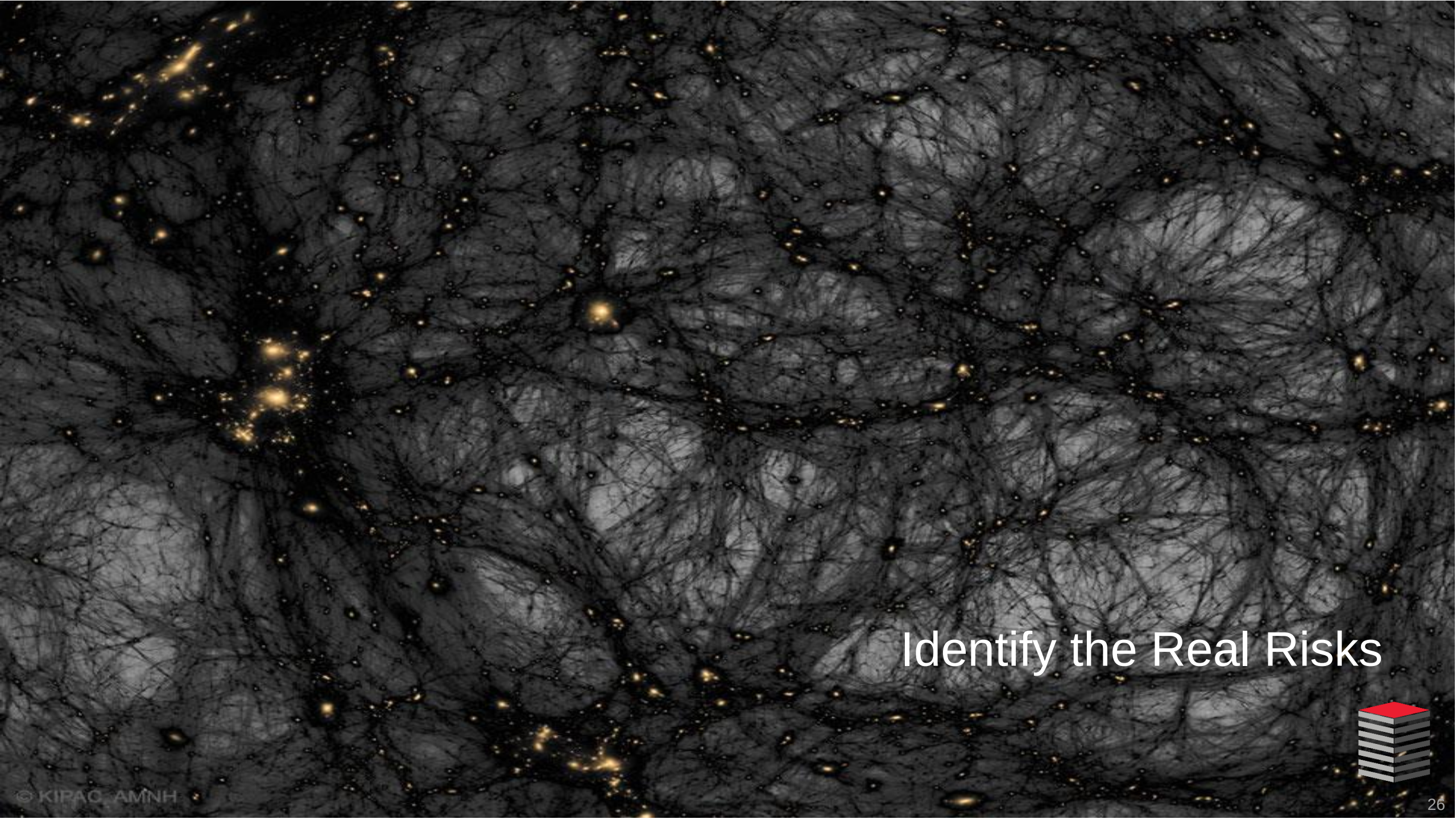


Take Notes ... Ask Questions

Presentation Caveats

- Security and Auditing are two entirely different things: Having one does not lessen the importance of having the other
- Auditing is critically important but essentially irrelevant to security

- Auditing
  - Auditing is the act of collecting and persisting metadata about activities: Who logged on, what did they do when they were logged on, when did they log off
  - Lots of organizations enable auditing ... but almost no one monitors the logs that are generated by audit activities
- Auditors
  - Auditors are people that, at least in theory, know enough about what your organization should be doing they can ascertain whether you are, indeed, actually doing it
  - Think about all of the internal and external audits your organization has passed over the years ... do you think that what got you past the audit made your organization secure?


Identify the Real Risks
© KIPAC, AMNH

Database Risks

- 99% of Oracle Database security activity focuses on what is a very small percentage of the overall threat
- Most databases break-ins are never detected and never reported
- What you hear about is the part of the iceberg above the water

- Database related risks fall into three broad categories
  - Data Theft
  - Data Alteration
  - Transforming the database into an attack tool
- To accomplish the above activities requires gaining access and doing so generally falls into one of the following categories
  - Utilizing granted privileges or through privilege escalation
  - Access to Oracle built-in packages
  - SQL Injection attacks

A Dose Of DBA Reality (1:2)

```
SQL> select utl_inaddr.get_host_address('www.umn.edu') from dual;

UTL_INADDR.GET_HOST_ADDRESS('WWW.UMN.EDU')
------------------------------------------
134.84.119.107

SQL> select utl_inaddr.get_host_name('134.84.119.025') from dual;

UTL_INADDR.GET_HOST_NAME('134.84.119.025')
------------------------------------------
g-smtp-w.tc.umn.edu
```

- It takes precisely this much PL/SQL to compromise an internal network

```
DECLARE
 h_name  VARCHAR2(60);
 test_ip VARCHAR2(12) := '134.84.119.';
 suffixn NUMBER(3) := 0;
 suffixv VARCHAR2(4);
BEGIN
  FOR i IN 1 .. 255 LOOP
    suffixn := suffixn + 1;
    IF suffixn < 10 THEN suffixv := '00' || TO_CHAR(suffixn);
    ELSIF suffixn BETWEEN 10 and 99 THEN suffixv := '0' || TO_CHAR(suffixn);
    ELSE suffixv := TO_CHAR(suffixn); END IF;
    BEGIN
      SELECT utl_inaddr.get_host_name(test_ip || suffixv)
      INTO h_name
      FROM dual;
      dbms_output.put_line(test_ip || suffixv || ' - ' || h_name);
    EXCEPTION WHEN OTHERS THEN NULL;
    END;
  END LOOP;
END;
/
```

A Dose Of DBA Reality (2:2)

- The listing output

```
134.84.119.001 - x-134-84-119-1.tc.umn.edu
134.84.119.002 - x-134-84-119-2.tc.umn.edu
134.84.119.003 - x-134-84-119-3.tc.umn.edu
134.84.119.004 - x-134-84-119-4.tc.umn.edu
134.84.119.005 - lsv-dd.tc.umn.edu
134.84.119.006 - mta-w2.tc.umn.edu
134.84.119.007 - isrv-w.tc.umn.edu
134.84.119.010 - mta-a2.tc.umn.edu
134.84.119.011 - x-134-84-119-9.tc.umn.edu
134.84.119.012 - x-134-84-119-10.tc.umn.edu
134.84.119.013 - x-134-84-119-11.tc.umn.edu
134.84.119.014 - x-134-84-119-12.tc.umn.edu
134.84.119.015 - x-134-84-119-13.tc.umn.edu
134.84.119.016 - x-134-84-119-14.tc.umn.edu
134.84.119.017 - diamond.tc.umn.edu
134.84.119.020 - x-134-84-119-16.tc.umn.edu
134.84.119.021 - oamethyst.tc.umn.edu
134.84.119.022 - x-134-84-119-18.tc.umn.edu
134.84.119.023 - x-134-84-119-19.tc.umn.edu
134.84.119.024 - vs-w.tc.umn.edu
134.84.119.025 - g-smtp-w.tc.umn.edu
134.84.119.026 - mta-w1.tc.umn.edu
134.84.119.027 - x-134-84-119-23.tc.umn.edu
134.84.119.030 - x-134-84-119-24.tc.umn.edu
134.84.119.031 - x-134-84-119-25.tc.umn.edu
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134.84.119.037 - ldap-w.tc.umn.edu
134.84.119.040 - mta-w3.tc.umn.edu
134.84.119.041 - x-134-84-119-33.tc.umn.edu
134.84.119.042 - x-134-84-119-34.tc.umn.edu
134.84.119.043 - smtp-w2.tc.umn.edu
134.84.119.044 - relay-w2.tc.umn.edu
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134.84.119.074 - isrv-d2.tc.umn.edu
134.84.119.075 - ldapauth-d2.tc.umn.edu.tc.umn.edu
134.84.119.076 - ldap-d2.tc.umn.edu.tc.umn.edu
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134.84.119.123 - x-134-84-119-123.tc.umn.edu
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134.84.119.137 - x-134-84-119-137.tc.umn.edu
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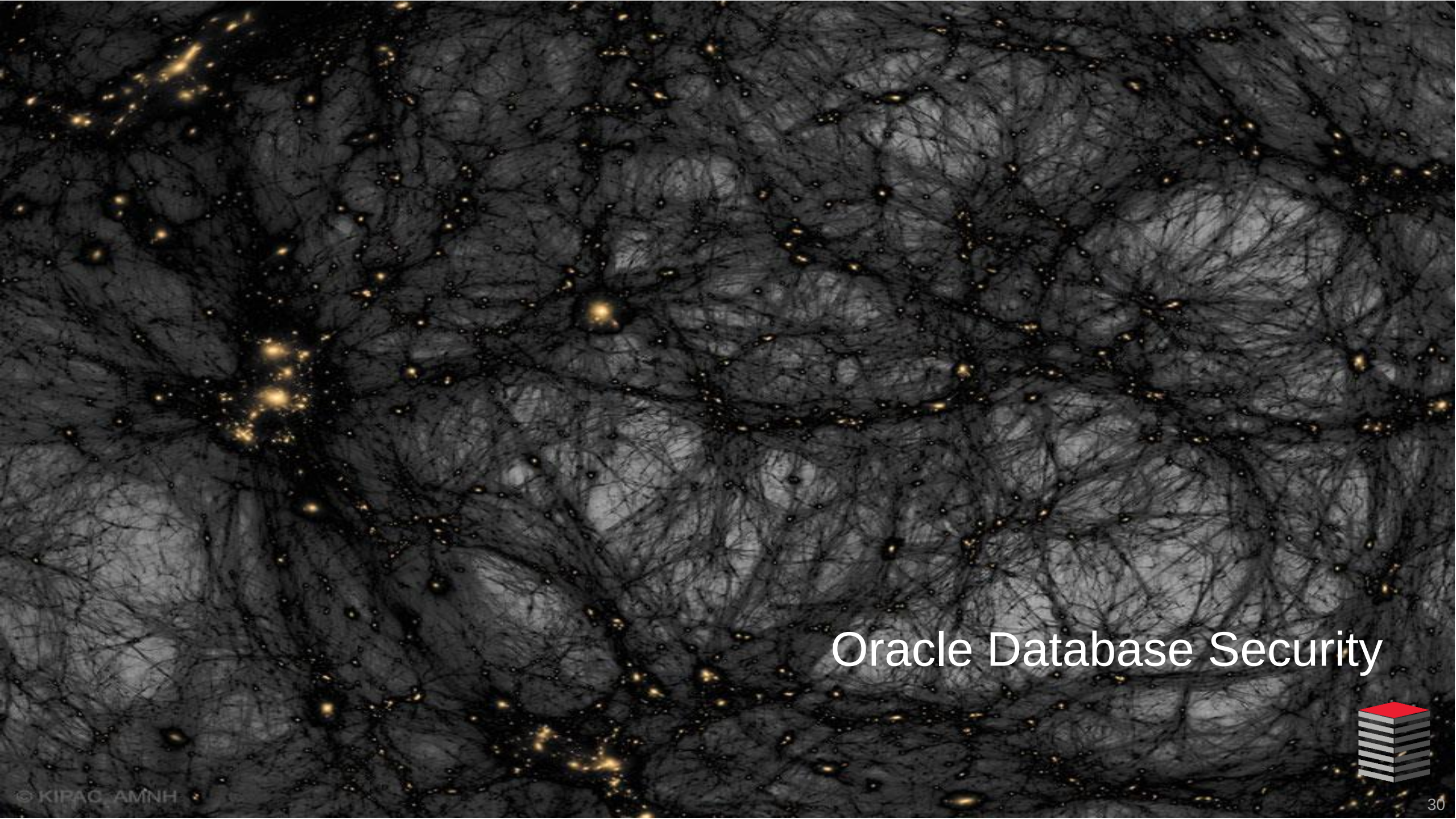


Oracle Database Security

The Concept

- To achieve a secure environment you must embrace the fact that the goal is not just to limit access: It is to secure data
- Securing the perimeter is a good first step
- Securing access is a step in the right direction but it does not 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 everything

- So let's take a quick look at the products and options Oracle makes available

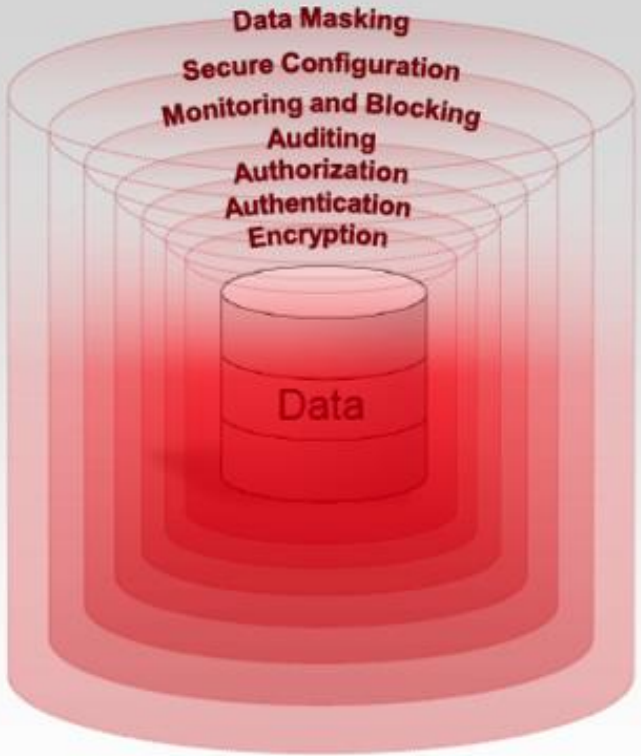
What The Leading Oracle Expert Says

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

SPARC T7 + Meta7 = x ... solve for x (1:2)

X = 'Stability + Security + Scalability'

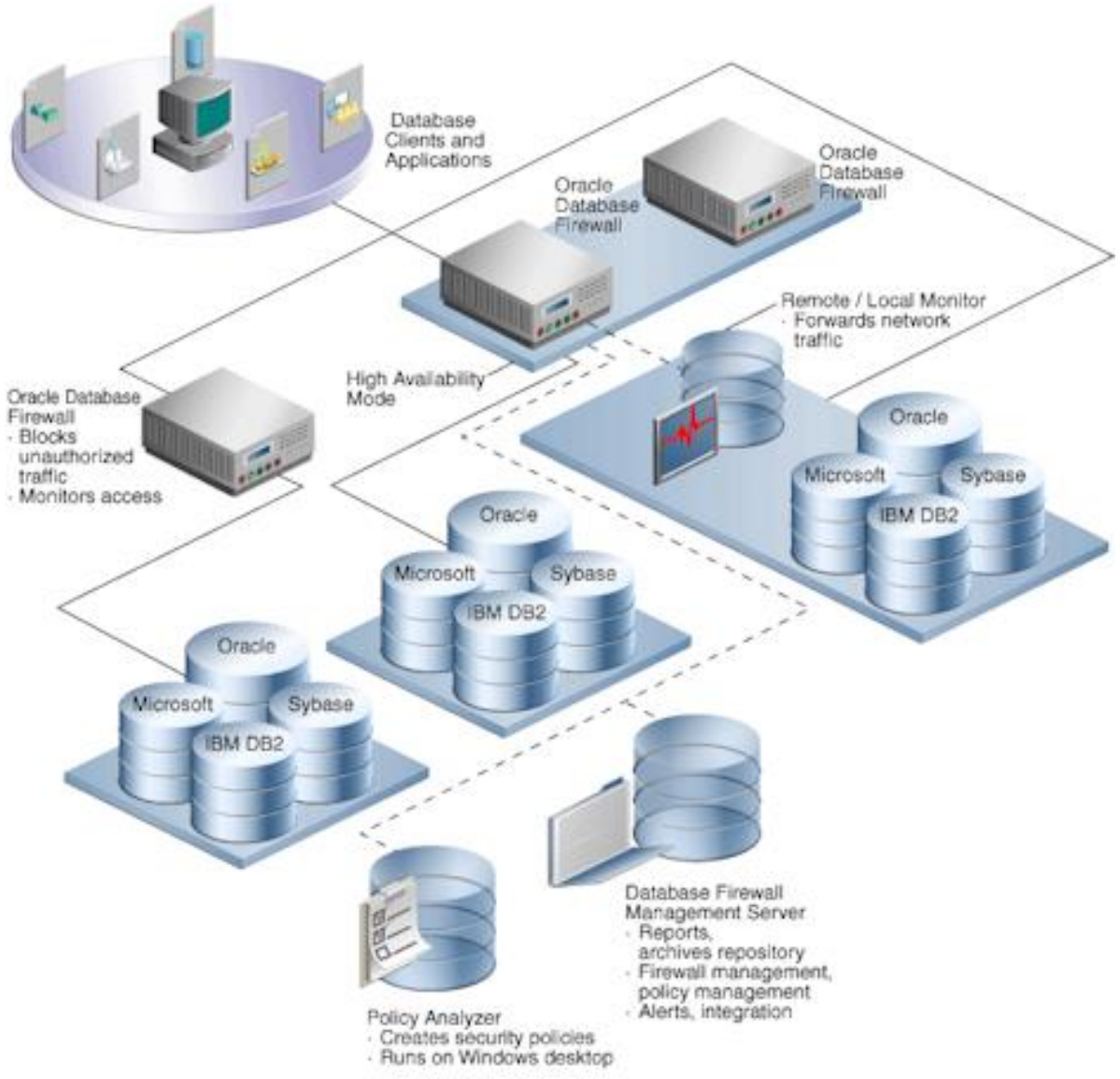
- With SPARC M7 we get Security on Silicon
  - SPARC M7 features co-processors dedicated to Oracle Database and Java processes
  - Many database functions bypass the general pool of cores and run on dedicated co-processors
  - Software in Silicon is yielding 10x improvement when the same workload is 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 (2:2)

- 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

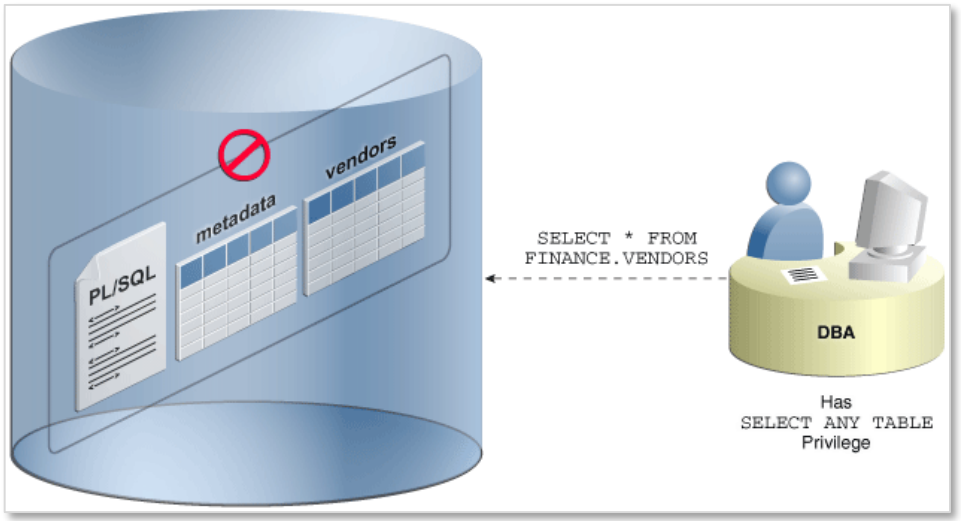
Database Firewall

- Secures and protects data in Oracle, MySQL, Microsoft SQL Server, Sybase Adaptive Server Enterprise (ASE), Sybase SQL Anywhere SQL, and IBM DB2 SQL
- Tools to assess vulnerabilities and enhances existing database security features, such as encryption and authentication
- Blocks attempted attacks, logs activity, and produces warnings
- Traditional systems test syntax of statements passed to the database, recognizing redefined expressions
- Analyzing the meaning of SQL and can prevent zero-day attack
- Protects against attacks originating from within the corporate network, as well as from external sources



Database Vault

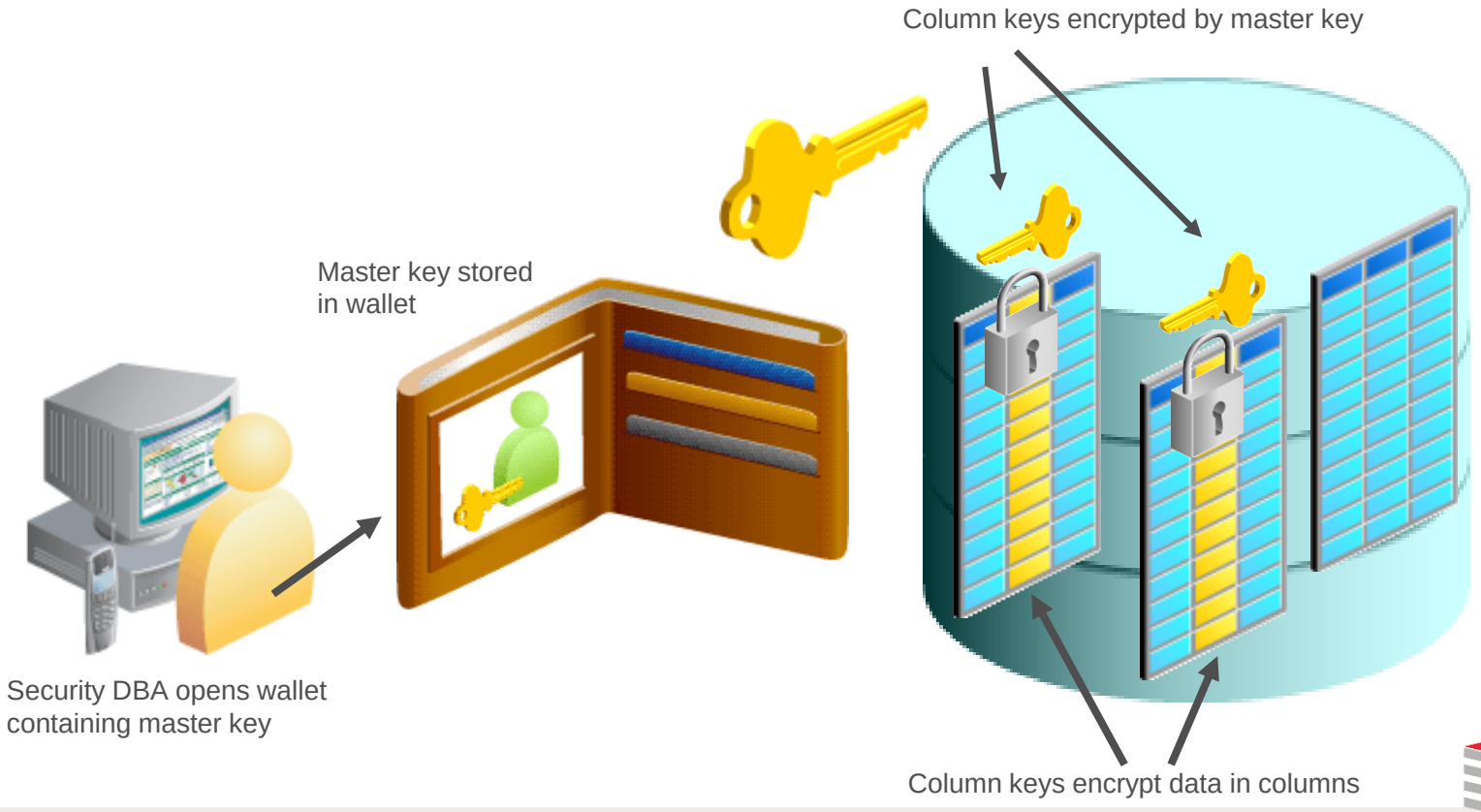
- Provides security controls to help protect application data from unauthorized access, and comply with privacy and regulatory requirements
- You can deploy controls to block privileged account access to application data and control sensitive operations inside the database using multi-factor authorization
- Secures existing database environments transparently, eliminating costly and time consuming application changes



- Creates an environment in which separation of duties can be effectively designed, deployed, and enforced through the creation of secure application roles that are enabled only by Database Vault rules

Wallets & Wallet Manager

- Wallets are a password-protected container used to store authentication and signing credentials, including private keys, certificates, and trusted certificates needed by SSL
- Wallet Manager supports the administrative tasks required for the creation and management of multiple wallets



Enterprise Edition Only (1:2)

- Advanced Security Option
  - Encryption through-out the database stack
- Data Masking
  - Selective, on-the-fly transformation to protect sensitive data
- Data Redaction (part of OAS)
  - Selective, on-the-fly redaction data transformation in SQL query results prior to display
- Database Vault
  - Protects sensitive data from access by users with privileged accounts
- Enterprise User Security
  - Integration of database user accounts with LDAP
- Label Security
  - Fine Grained Access Control extended to finer granularity and control
- Network Encryption (SSL/TLS)
  - Encryption of communications between the database and clients, applications, backups utilities, and DR facilities

Enterprise Edition Only (2:2)

- Privilege Analysis
  - Analyses assigned privileges
- Real Application Security
  - Second generation VPD
- Secure External Password Store
  - Uses an Oracle Wallet to hold password credentials
- 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

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;
 /
```

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

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
```

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

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;
/
```

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

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;
```

Perimeter Defense

Database Networks

- Attempts are being made essentially 7 x 24 x 365 to attack your organizations
- If you do not know this then you have insufficient monitoring and most likely many of the attempts are success
- A small division of one of America's largest retailers has not been able to identify a single 24 hour period in the last 5 years during which there was not at least one serious, professional, attempt to access their data

Database Networks

- Every Oracle Database deployment requires multiple network connections

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	RMAN, DataPump, CommVault, Data Domain, ZFS, ZDLRA

- Every one of these networks provides access to critical infrastructure
- No conversation on networking is complete without considering firewalls, DNS and NTP servers, load balancers, and a large variety of mobile and Internet of Things devices

Firewalls (1:2)

- Many organizations think they are protected because they have 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 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 purchased and configured should give you no sense of comfort
- Here is another firewall rule setting discovered during a security audit
- This 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 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
```

Security Breach Root Cause Analysis

Internal vs. External Threats

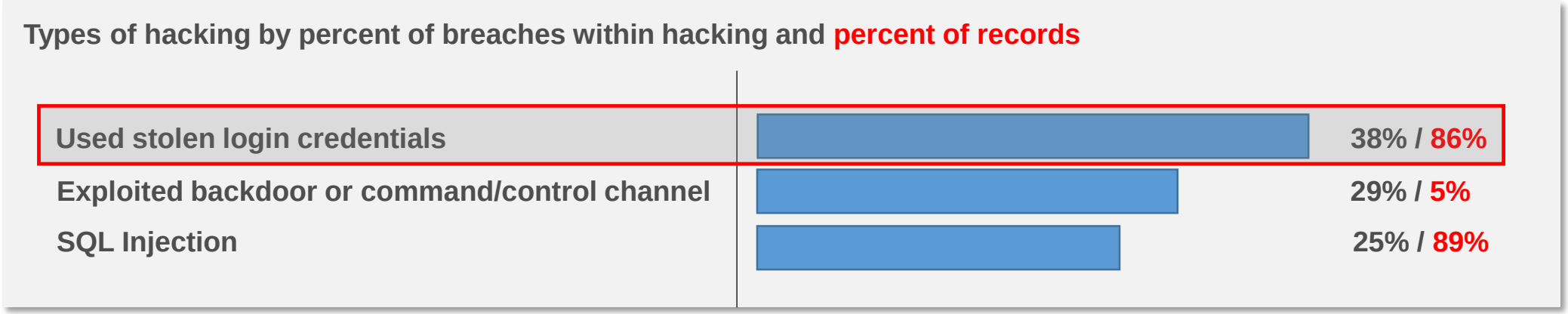
- Most organizations focus on the least likely threats and ignore what has been historically proven to be the largest threat
- The following is quoted from "Reference for Business" on the subject of computer crimes

> **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 and minimize our organization's risk exposure
- The other part is educational ... to educate our internal and external customers on the nature of real-world threats
- The education needs to come from us ... not from someone in sales

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

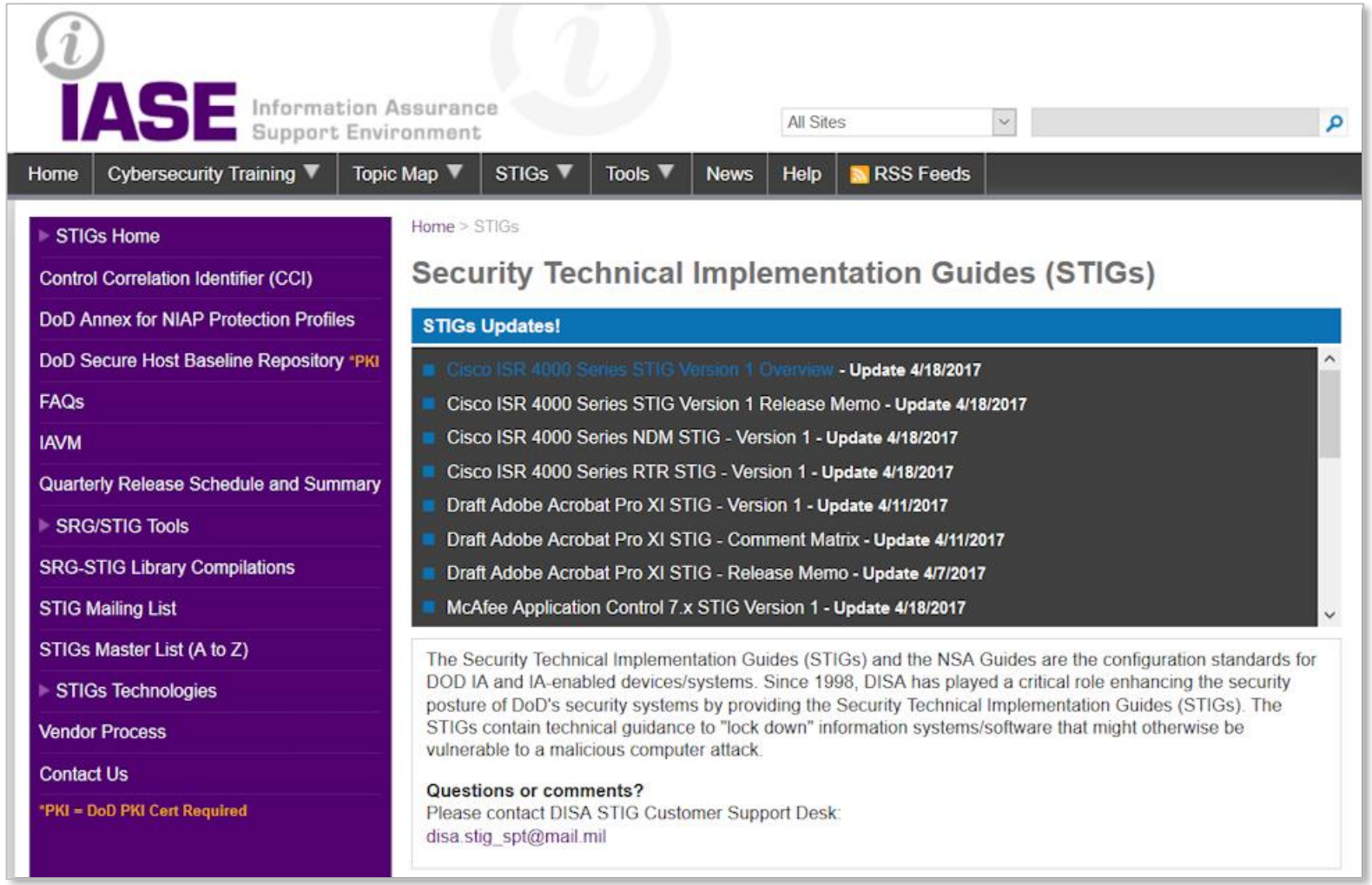
Misdirected By The Media

- What does the IC3 have to do with securing data?
- Nothing!
- All of this is focused on how cyber-criminals get 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

Gaining Access

STIG (1:3)



`http://iase.disa.mil/stigs/Pages/index.aspx`

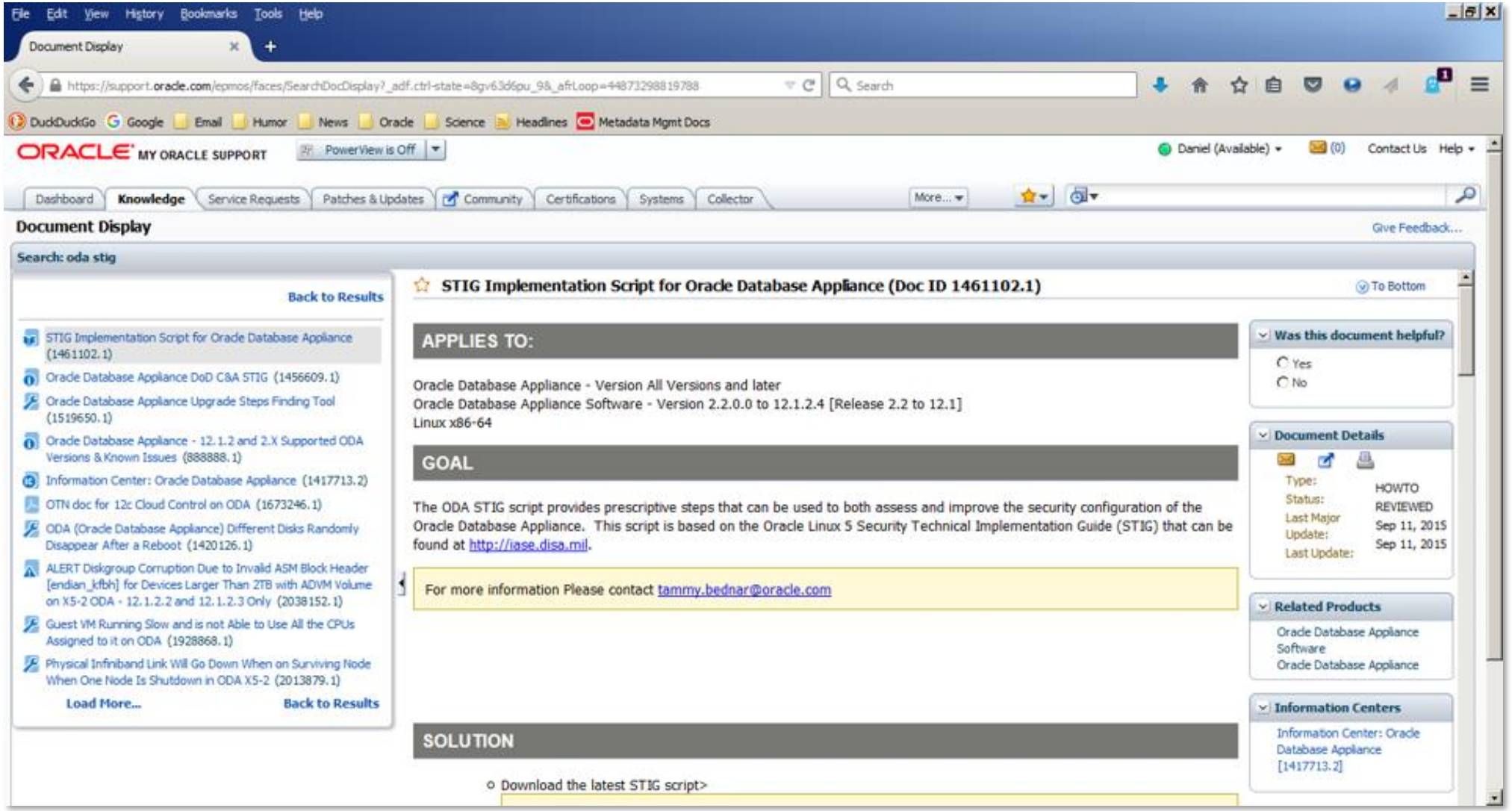
STIG (2:3)

- 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

Warning: Never run the STIG script with the -fix option

- Ctrl-Alt-Del combination to shutdown system is enabled
- Password for grub not enabled
- Privilege account 'halt' is present
- Privilege account 'shutdown' is present
- RealVNC rpm is installed on system
- sendmail decode command is not commented in /etc/aliases
- Support for USB device found in kernel

STIG (3:3)


Document Display
ORACLE MY ORACLE SUPPORT
Dashboard
Knowledge
Service Requests
Patches & Updates
Community
Certifications
Systems
Collector
Document Display
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]

Center For Internet Security (CIS)

- CIS is the source of audit guidelines and auditors for e-commerce websites

`https://www.cisecurity.org`

User Management

Application Access

- At many major Oracle customers there are two types of users defined
  - human: a sentient human will user this user-id to log on
  - mechid: an application or application server will use this user-id to connect
- All application schemas should be created with a mechid
- Application schemas should be granted the privileges required to create objects then
  - Revoke all system privileges from the application schema
  - Lock the schema and expire the password
  - Audit attempts to log onto the application schema directly

```
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
```

Users

New: 12cR1

AUDSYS
GSMADMIN_INTERNAL
GSMCATUSER
GSMUSER
PDBADMIN
SYSBACKUP
SYSDG
SYSKM

New: 12cR2

APEX_050100
APEX_INSTANCE_ADMIN_USER
APEX_LISTENER
APEX_REST_PUBLIC_USER
DBJSON
DBSFWUSER
GGSYS
HRREST
OBE
ORDS_METADATA
ORDS_PUBLIC_USER
PDBADMIN
REMOTE_SCHEDULER_AGENT
RESTFUL
SYS$UMF
SYSRAC
XDBEXT
XDBPM
XFILES

Dropped
BI, OE, PM, SH, and SPATIAL_WFS_USR

New Users With Escalated Privs

USERNAME	Usage
GGSYS	The internal account used by Oracle GoldenGate. It should not be unlocked or used for a database login.
SYSBACKUP	This privilege allows a user to perform backup and recovery operations either from Oracle Recovery Manager (RMAN) or SQL*Plus.
SYSDG	This privilege allows a user to perform Data Guard operations can use this privilege with either Data Guard Broker or the DGMGRL command-line interface.
SYSKM	This privilege allows a user to perform Transparent Data Encryption keystore operations.
SYSRAC	This privilege allows the Oracle agent of Oracle Clusterware to perform Oracle Real Application Clusters (Oracle RAC) operations. SYSRAC facilitates Oracle Real Application Clusters (Oracle RAC) operations by connecting to the database by the Clusterware agent on behalf of Oracle RAC utilities such as SRVCTL.

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.

- And, of course Tom Kyte was correct

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
- 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 which, of course, you cannot do
- CIS audit check 4.07 specifically checks for the use of externally authenticated access

```
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 (1:4)

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 (2:4)

12cR1 Default

COMPOSITE_LIMIT	UNLIMITED
CONNECT_TIME	UNLIMITED
CPU_PER_CALL	UNLIMITED
CPU_PER_SESSION	UNLIMITED
FAILED_LOGIN_ATTEMPTS	10
IDLE_TIME	UNLIMITED
LOGICAL_READS_PER_CALL	UNLIMITED
LOGICAL_READS_PER_SESSION	UNLIMITED
PASSWORD_GRACE_TIME	7
PASSWORD_LIFE_TIME	180
PASSWORD_LOCK_TIME	1
PASSWORD_REUSE_MAX	UNLIMITED
PASSWORD_REUSE_TIME	UNLIMITED
PASSWORD_VERIFY_FUNCTION	NULL
PRIVATE_SGA	UNLIMITED
SESSIONS_PER_USER	UNLIMITED

12cR2 ORA_STIG_PROFILE

COMPOSITE_LIMIT	UNLIMITED
CONNECT_TIME	UNLIMITED
CPU_PER_CALL	UNLIMITED
CPU_PER_SESSION	UNLIMITED
FAILED_LOGIN_ATTEMPTS	3
IDLE_TIME	15
INACTIVE_ACCOUNT_TIME	35
LOGICAL_READS_PER_CALL	UNLIMITED
LOGICAL_READS_PER_SESSION	UNLIMITED
PASSWORD_GRACE_TIME	5
PASSWORD_LIFE_TIME	60
PASSWORD_LOCK_TIME	UNLIMITED
PASSWORD_REUSE_MAX	10
PASSWORD_REUSE_TIME	265
PASSWORD_VERIFY_FUNCTION	ORA12C_STIG_VERIFY_FUNCTION
PRIVATE_SGA	UNLIMITED
SESSIONS_PER_USER	UNLIMITED

Starting with this release, you can use the INACTIVE_ACCOUNT_TIME parameter to automatically lock the account of a database user who has not logged in to the database instance in a specified number of days.

Profiles (3:4)

- Run $ORACLE_HOME/rdbms/admin/utlpwdmg.sql

```
-- 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
FAILED_LOGIN_ATTEMPTS        10
INACTIVE_ACCOUNT_TIME UNLIMITED
PASSWORD_GRACE_TIME           7
PASSWORD_LIFE_TIME    UNLIMITED
PASSWORD_LOCK_TIME            1
PASSWORD_REUSE_TIME   UNLIMITED
PASSWORD_REUSE_MAX    UNLIMITED
PASSWORD_VERIFY_FUNCTION ora12c_verify_function;
```

Profiles (4:4)

- Uncomment the CIS or STIG profiles for improved 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 180
PASSWORD_GRACE_TIME 7
PASSWORD_REUSE_TIME UNLIMITED
PASSWORD_REUSE_MAX  UNLIMITED
FAILED_LOGIN_ATTEMPTS 10
PASSWORD_LOCK_TIME 1
INACTIVE_ACCOUNT_TIME UNLIMITED
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;*/
```

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`** is run

Roles (1:2)

- 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

Roles (2:2)

12cR1 New
ADM_PARALLEL_EXECUTE_TASK
APEX_GRANTS_FOR_NEW_USERS_ROLE
AUDIT_ADMIN
AUDIT_VIEWER
CAPTURE_ADMIN
CDB_DBA
DBAHADOOP
DV_AUDIT_CLEANUP
DV_GOLDENGATE_ADMIN
DV_GOLDENGATE_REDO_ACCESS
DV_MONITOR
DV_PATCH_ADMIN
DV_STREAMS_ADMIN
DV_XSTREAM_ADMIN
EM_EXPRESS_ALL
EM_EXPRESS_BASIC
GSMADMIN_ROLE
GSMUSER_ROLE
GSM_POOLADMIN_ROLE
HS_ADMIN_SELECT_ROLE
LBAC_DBA
OPTIMIZER_PROCESSING_RATE
PDB_DBA
PROVISIONER
XS_CACHE_ADMIN
XS_NAMESPACE_ADMIN
XS_RESOURCE
XS_SESSION_ADMIN

12cR1 Dropped
DELETE_CATALOG_ROLE

12cR2 New
APEX_ADMINISTRATOR_READ_ROLE
APPLICATION_TRACE_VIEWER
DATAPATCH_ROLE
DBJAVASCRIPT
DBMS_MDX_INTERNAL
DV_POLICY_OWNER
GGSYS_ROLE
RDFCTX_ADMIN
RECOVERY_CATALOG_OWNER_VPD
SODA_APP
SYSUMF_ROLE
XFILES_ADMINISTRATOR
XFILES_USER
XS_CONNECT

12cR2 Dropped
DBAHADOOP
SPATIAL_WFS_ADMIN
WFS_USR_ROLE
XS_RESOURCE

System & Object Privs

Granting Privileges

- 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
- If you have not done so in the last 12 months review all users for their system privileges and revoke those not required
- 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 Granted to the DBA Role

```
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 any of the privileges highlighted in red

System Privileges

12cR1 New
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

12cR2 New
ALTER ANY ANALYTIC VIEW
CREATE ANALYTIC VIEW
CREATE ANY ANALYTIC VIEW
DROP ANY ANALYTIC VIEW

ALTER ANY ATTRIBUTE DIMENSION
CREATE ANY ATTRIBUTE DIMENSION
CREATE ATTRIBUTE DIMENSION
DROP ANY ATTRIBUTE DIMENSION

ALTER ANY HIERARCHY
CREATE ANY HIERARCHY
CREATE HIERARCHY
DROP ANY HIERARCHY

ALTER LOCKDOWN PROFILE
CREATE LOCKDOWN PROFILE
DROP LOCKDOWN PROFILE

DEBUG CONNECT ANY

INHERIT ANY REMOTE PRIVILEGES

SYSRAC

USE ANY JOB RESOURCE

12cR2 Modified
SELECT ANY DICTIONARY (altered in 12.1.0.2 to exclude some objects)

Object Privileges (1:10)

- 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 or because someone had insufficient privileges

Object Privileges (2:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
SELECT 'REVOKE SELECT ON ' || table_name || ' FROM PUBLIC;' AS RUN_SCRIPT
FROM dba_tab_privs
WHERE grantee = 'PUBLIC'
AND table_name LIKE 'DBA%'
ORDER BY 1;

RUN_SCRIPT
------------------------------------------------------------
REVOKE SELECT ON DBA_AUTO_SEGADV_CTL FROM PUBLIC;
REVOKE SELECT ON DBA_AUTO_SEGADV_SUMMARY FROM PUBLIC;
REVOKE SELECT ON DBA_COL_PENDING_STATS FROM PUBLIC;
REVOKE SELECT ON DBA_COL_USAGE_STATISTICS FROM PUBLIC;
REVOKE SELECT ON DBA_DBFS_HS_FIXED_PROPERTIES FROM PUBLIC;
REVOKE SELECT ON DBA_EDITIONING_VIEW_COLS FROM PUBLIC;
REVOKE SELECT ON DBA_EDITIONING_VIEW_COLS_AE FROM PUBLIC;
REVOKE SELECT ON DBA_EXPRESSION_STATISTICS FROM PUBLIC;
REVOKE SELECT ON DBA_FLASHBACK_ARCHIVE FROM PUBLIC;
REVOKE SELECT ON DBA_FLASHBACK_ARCHIVE_TABLES FROM PUBLIC;
REVOKE SELECT ON DBA_FLASHBACK_ARCHIVE_TS FROM PUBLIC;
REVOKE SELECT ON DBA_HEAT_MAP_SEGMENT FROM PUBLIC;
REVOKE SELECT ON DBA_HEAT_MAP_SEG_HISTOGRAM FROM PUBLIC;
REVOKE SELECT ON DBA_IND_PENDING_STATS FROM PUBLIC;
REVOKE SELECT ON DBA_JAVA_CLASSES FROM PUBLIC;
REVOKE SELECT ON DBA_SDO_MAPS FROM PUBLIC;
REVOKE SELECT ON DBA_SDO_STYLES FROM PUBLIC;
REVOKE SELECT ON DBA_SDO_THEMES FROM PUBLIC;
REVOKE SELECT ON DBA_SR_PARTN_OPS FROM PUBLIC;
REVOKE SELECT ON DBA_SR_STLOG_STATS FROM PUBLIC;
REVOKE SELECT ON DBA_SYNC_CAPTURE_TABLES FROM PUBLIC;
REVOKE SELECT ON DBA_TAB_HISTGRM_PENDING_STATS FROM PUBLIC;
REVOKE SELECT ON DBA_TAB_PENDING_STATS FROM PUBLIC;
REVOKE SELECT ON DBA_TAB_STAT_PREFS FROM PUBLIC;
REVOKE SELECT ON DBA_TSTZ_TABLES FROM PUBLIC;
REVOKE SELECT ON DBA_XMLSCHEMA_LEVEL_VIEW FROM PUBLIC;
```

Object Privileges (3:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
SELECT UNIQUE 'REVOKE EXECUTE ON ' || table_name || ' FROM PUBLIC;' AS
RUN_SCRIPT
FROM dba_tab_privs dtp
WHERE dtp.grantee = 'PUBLIC'
AND dtp.privilege = 'EXECUTE'
AND dtp.type = 'PACKAGE'
AND ((dtp.table_name LIKE 'DBMS%') OR (dtp.table_name LIKE 'UTL%'))
ORDER BY 1;

RUN_SCRIPT
----------------------------------------------------------------
EVOKE EXECUTE ON DBMS_ADDM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ADVISOR FROM PUBLIC;
REVOKE EXECUTE ON DBMS_APPLICATION_INFO FROM PUBLIC;
REVOKE EXECUTE ON DBMS_APP_CONT_PRVT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQJMS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_CMT_TIME_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_DEQUEUELOG_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_HISTORY_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_INDEX_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_QUEUES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_QUEUE_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_SIGNATURE_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_SUBSCRIBER_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_EXP_TIMEMGR_TABLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_IMP_INTERNAL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AQ_INV FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ASSERT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AUTO_REPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AUTO_TASK FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AW FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AW_EXP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AW_STATS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_AW_XML FROM PUBLIC;
```

Object Privileges (4:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
REVOKE EXECUTE ON DBMS_CDC_ISUBSCRIBE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CDC_SUBSCRIBE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CLOBUTIL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_COMPRESSION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CREDENTIAL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CRYPTO_TOOLKIT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CSX_INT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CSX_INT2 FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CUBE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CUBE_ADVISE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CUBE_ADVISE_SEC FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CUBE_EXP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CUBE_LOG FROM PUBLIC;
REVOKE EXECUTE ON DBMS_CUBE_UTIL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DATAPUMP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DATA_MINING FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DATA_MINING_TRANSFORM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DB_VERSION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DDL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DEBUG FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DEBUG_JDWP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DEBUG_JDWP_CUSTOM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DESCRIBE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DIMENSION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DM_MODEL_EXP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_DM_MODEL_IMP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_EDITIONS_UTILITIES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_EPG FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ERRLOG FROM PUBLIC;
REVOKE EXECUTE ON DBMS_EXPORT_EXTENSION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_FBT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_FILE_GROUP_EXP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_FILE_GROUP_IMP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_FREQUENT_ITEMSET FROM PUBLIC;
```

Object Privileges (5:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
REVOKE EXECUTE ON DBMS_GOLDENGATE_EXP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_GOLDENGATE_IMP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_GSM_NOPRIV FROM PUBLIC;
REVOKE EXECUTE ON DBMS_HEAT_MAP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_HIERARCHY FROM PUBLIC;
REVOKE EXECUTE ON DBMS_HS_PARALLEL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ILM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_INDEX_UTL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_INMEMORY FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ITRIGGER_UTL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_JAVA FROM PUBLIC;
REVOKE EXECUTE ON DBMS_JAVASCRIPT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_JOB FROM PUBLIC;
REVOKE EXECUTE ON DBMS_JSON FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LCR FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LDAP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LDAP_UTL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LOB FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LOBUTIL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LOGREP_EXP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LOGREP_IMP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_LOGSTDBY_CONTEXT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_MACOLS_SESSION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_MACSEC_ROLES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_MDX_ODBO FROM PUBLIC;
REVOKE EXECUTE ON DBMS_METADATA FROM PUBLIC;
REVOKE EXECUTE ON DBMS_METADATA_DIFF FROM PUBLIC;
REVOKE EXECUTE ON DBMS_MVIEW_STATS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_NETWORK_ACL_UTILITY FROM PUBLIC;
REVOKE EXECUTE ON DBMS_OBFUSCATION_TOOLKIT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_OBJECTS_UTILS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ODCI FROM PUBLIC;
REVOKE EXECUTE ON DBMS_OUTPUT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PARALLEL_EXECUTE FROM PUBLIC;
```

Object Privileges (6:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
REVOKE EXECUTE ON DBMS_PART FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PCLXUTIL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PICKLER FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PLSQL_CODE_COVERAGE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PREDICTIVE_ANALYTICS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PREPROCESSOR FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PROFILER FROM PUBLIC;
REVOKE EXECUTE ON DBMS_PSP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RANDOM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_REFRESH FROM PUBLIC;
REVOKE EXECUTE ON DBMS_REPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RESCONFIG FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RESOURCE_MANAGER FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RESOURCE_MANAGER_PRIVS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RESULT_CACHE_API FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RMGR_GROUP_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RMGR_PACT_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RMGR_PLAN_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RMIN FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ROWID FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULEADM_INTERNAL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULE_ADM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULE_EXP_EV_CTXS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULE_EXP_RULES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULE_EXP_RULE_SETS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULE_EXP_UTLI FROM PUBLIC;
REVOKE EXECUTE ON DBMS_RULE_IMP_OBJ FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHEDULER FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_ATTRIBUTE_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_CHAIN_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_CLASS_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_CONSTRAINT_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_CREDENTIAL_EXPORT FROM PUBLIC;
```

Object Privileges (7:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
REVOKE EXECUTE ON DBMS_SCHED_EXPORT_CALLOUTS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_FILE_WATCHER_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_JOB_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_PROGRAM_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_SCHEDULE_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_WINDOW_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCHED_WINGRP_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SCN FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SESSION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SNAPSHOT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SNAPSHOT_UTL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SODA_DOM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SPACE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SPD FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SPM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQL FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQLDIAG FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQLPA FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQLTUNE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQLTUNE_UTIL2 FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQL_MONITOR FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQL_TRANSLATOR FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SQL_TRANSLATOR_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_STANDARD FROM PUBLIC;
REVOKE EXECUTE ON DBMS_STATS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_STATS_ADVISOR FROM PUBLIC;
REVOKE EXECUTE ON DBMS_STAT_FUNCS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_STAT_FUNCS_AUX FROM PUBLIC;
REVOKE EXECUTE ON DBMS_STREAMS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_STREAMS_PUB_RPC FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SUMMARY FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SUM_RWEQ_EXPORT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_SYNC_REFRESH FROM PUBLIC;
REVOKE EXECUTE ON DBMS_TF FROM PUBLIC;
```

Object Privileges (8:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
REVOKE EXECUTE ON DBMS_TRACE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_TRANSACTION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_TRANSFORM_EXIMP FROM PUBLIC;
REVOKE EXECUTE ON DBMS_TYPES FROM PUBLIC;
REVOKE EXECUTE ON DBMS_UTILITY FROM PUBLIC;
REVOKE EXECUTE ON DBMS_WARNING FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XA FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDB FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDBNFS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDBRESOURCE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDBUTIL_INT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDBZ FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDBZ0 FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDB_CONFIG FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDB_CONSTANTS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDB_CONTENT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDB_PRINT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDB_REPOS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XDB_VERSION FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XEVENT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XLSB FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLDOM FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLGEN FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLINDEX FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLINDEX0 FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLPARSER FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLQUERY FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLSAVE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLSCHEMA FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLSCHEMA_ANNOTATE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLSCHEMA_INT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLSCHEMA_LSB FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLSTORAGE_MANAGE FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XMLSTORE FROM PUBLIC;
```

Object Privileges (9:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
REVOKE EXECUTE ON DBMS_XMLTRANSLATIONS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XPLAN FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XQUERY FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XQUERYINT FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XSLPROCESSOR FROM PUBLIC;
REVOKE EXECUTE ON DBMS_XS_SESSIONS FROM PUBLIC;
REVOKE EXECUTE ON DBMS_ZHELP_IR FROM PUBLIC;
REVOKE EXECUTE ON UTL_CALL_STACK FROM PUBLIC;
REVOKE EXECUTE ON UTL_COLL FROM PUBLIC;
REVOKE EXECUTE ON UTL_COMPRESS FROM PUBLIC;
REVOKE EXECUTE ON UTL_ENCODE FROM PUBLIC;
REVOKE EXECUTE ON UTL_FILE FROM PUBLIC;
REVOKE EXECUTE ON UTL_GDK FROM PUBLIC;
REVOKE EXECUTE ON UTL_HTTP FROM PUBLIC;
REVOKE EXECUTE ON UTL_I18N FROM PUBLIC;
REVOKE EXECUTE ON UTL_IDENT FROM PUBLIC;
REVOKE EXECUTE ON UTL_INADDR FROM PUBLIC;
REVOKE EXECUTE ON UTL_LMS FROM PUBLIC;
REVOKE EXECUTE ON UTL_MATCH FROM PUBLIC;
REVOKE EXECUTE ON UTL_NLA FROM PUBLIC;
REVOKE EXECUTE ON UTL_RAW FROM PUBLIC;
REVOKE EXECUTE ON UTL_REF FROM PUBLIC;
REVOKE EXECUTE ON UTL_SMTP FROM PUBLIC;
REVOKE EXECUTE ON UTL_TCP FROM PUBLIC;
REVOKE EXECUTE ON UTL_URL FROM PUBLIC;
```

Object Privileges (10:10)

- Review each of these grants to PUBLIC and determine which are necessary and which put your database and data at risk
- Before removing any granted privilege be sure to validate the non-impact of the change in a QA environment

```
SELECT 'REVOKE SELECT ON ' || table_name || ' FROM PUBLIC;' AS RUN_SCRIPT
FROM dba_tab_privs
WHERE grantee = 'PUBLIC'
AND table_name LIKE 'ALL%'
ORDER BY 1;

REVOKE SELECT ON ALL_ALL_TABLES FROM PUBLIC;
REVOKE SELECT ON ALL_DB_LINKS FROM PUBLIC;
REVOKE SELECT ON ALL_EDITIONING_VIEWS_AE FROM PUBLIC;
REVOKE SELECT ON ALL_ENCRYPTED_COLUMNS FROM PUBLIC;
REVOKE SELECT ON ALL_JAVA_ARGUMENTS FROM PUBLIC;
REVOKE SELECT ON ALL_OBJECTS FROM PUBLIC;
REVOKE SELECT ON ALL_OBJECTS_AE FROM PUBLIC;
REVOKE SELECT ON ALL_OPERATORS FROM PUBLIC;
REVOKE SELECT ON ALL_OPERATOR_COMMENTS FROM PUBLIC;
REVOKE SELECT ON ALL_PROCEDURES FROM PUBLIC;
REVOKE SELECT ON ALL_SOURCE FROM PUBLIC;
REVOKE SELECT ON ALL_SOURCE_AE FROM PUBLIC;
```

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%'
```

SQL*Net

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 attacker must check in a single command
- Changing the port is item 2.11 on the CIS audit but it secures nothing

```
[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...)
  - DBA team members

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 does not provide any security.

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

SEC_PROTOCOL_ERROR_TRACE_ACTION

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 ALERT on 15-MAR-2016'** **SID='*'** **SCOPE=BOTH;**

Built-in Packages

File System Access Risks (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 Risks (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;

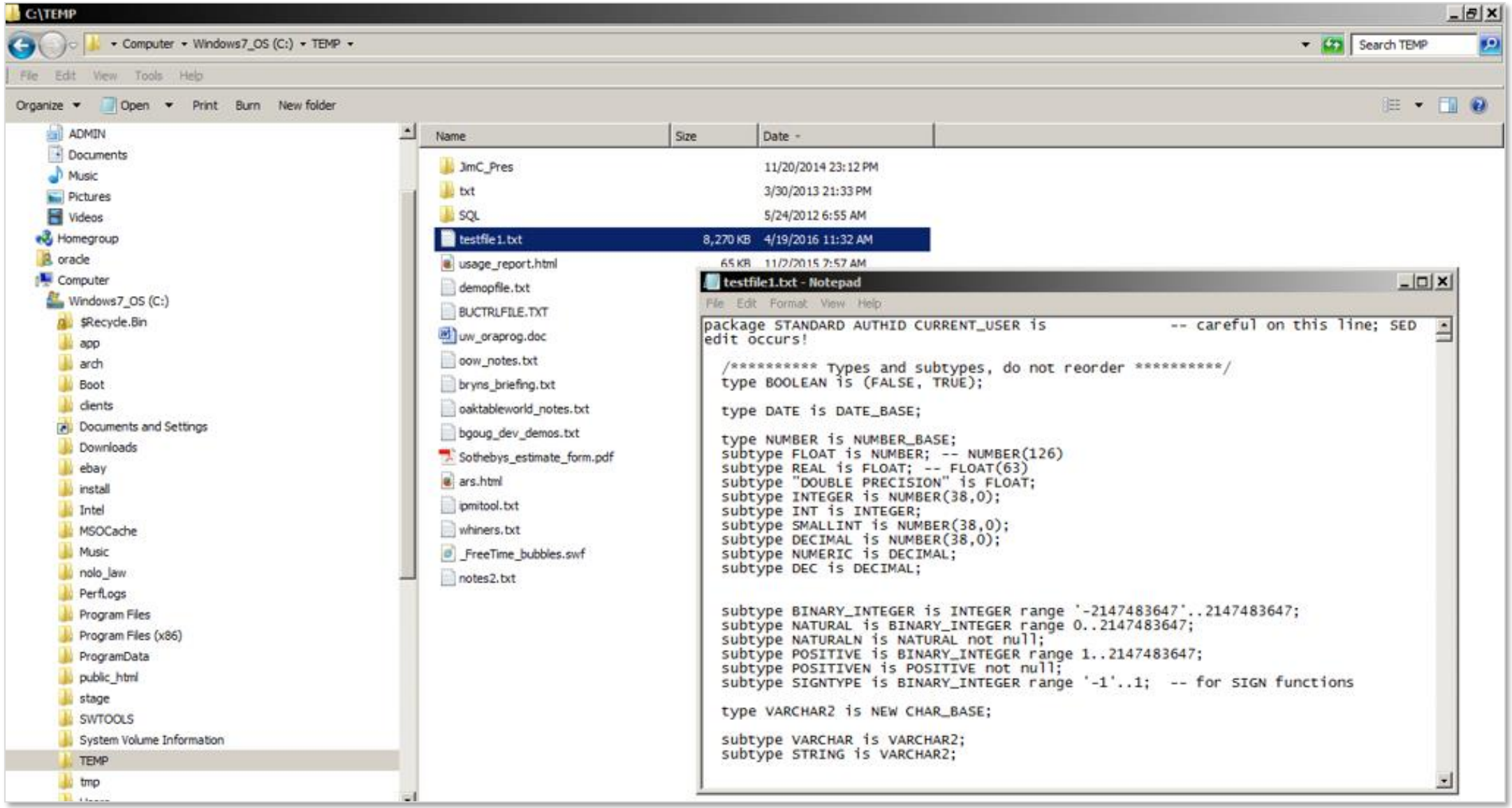
LENGTH(TEXTCOL)
---------------
        8258936
```

```
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 Risks (3:5)



File System Access Risks (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 Risks (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 Access Risks (1:2)

- 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 Access Risks (2:2)

- DBMS_NETWORK_ACL_ADMIN
  - Use to create Access Control Lists
- DBMS_NETWORK_ACL_UTILITY
  - Provides the utility functions that facilitate managing network access permissions
- UTL_HTTP
  - Has been used to capture websites and their content including code, images, and video
- UTL_INADDR
  - Can be used to interrogate DNS resources
- UTL_MAIL
  - Can be used to send data out of the database
- UTL_SMTP
  - Can be used to send data out of the database
- UTL_TCP
  - Supports application communications with external TCP/IP-based servers

DBMS_NETWORK_ACL_ADM/UTILITY (1:2)

```
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
```

DBMS_NETWORK_ACL_ADM/UTILITY (2:2)

```
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
```

UTL_HTTP

```
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;
/
```

Other Built-In Packages

DBMS_CREDENTIAL (1:2)

- 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 = 'DBMS_CREDENTIAL';

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

DBMS_CREDENTIAL (2:2)

```
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;
```

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
```

SQL Injection

SQL Injection

- 25% of all attacks are by SQL Injection ... and 89% of all data stolen is the result of a SQL Injection attack
- If you do not know how to attack your databases ... you cannot prevent an attack?
- To prevent SQL Injection attacks
  - Use Bind Variables
  - Use DBMS_ASSERT

```
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
```

Miscellaneous Topics

ACCESSIBLE BY Clause

- Used in PL/SQL to control access within a schema so packages, procedures, and functions can only be executed by specifically named objects

```
CREATE OR REPLACE FUNCTION test_src RETURN PLS_INTEGER
ACCESSIBLE BY (FUNCTION test_yes) AUTHID DEFINER IS
BEGIN
  RETURN 42;
END test_src;
/

CREATE OR REPLACE FUNCTION test_yes RETURN PLS_INTEGER AUTHID
DEFINER IS
BEGIN
  RETURN test_src;
END test_yes;
/

CREATE OR REPLACE FUNCTION test_no RETURN PLS_INTEGER AUTHID DEFINER
IS
BEGIN
  RETURN test_src;
END test_no;
/

Warning: Function created with compilation errors.

SQL> show err
Errors for FUNCTION TEST_NO:

LINE/COL ERROR
-------- ------
3/3      PL/SQL: Statement ignored
3/10     PLS-00904: insufficient privilege to access object TEST_SRC
```

Encryption & Hashing

- 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
  - DBMS_CRYPTO
  - STANDARD_HASH
- Encryption is of limited value unless executed by the application before the values get to the database

```
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.
```

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

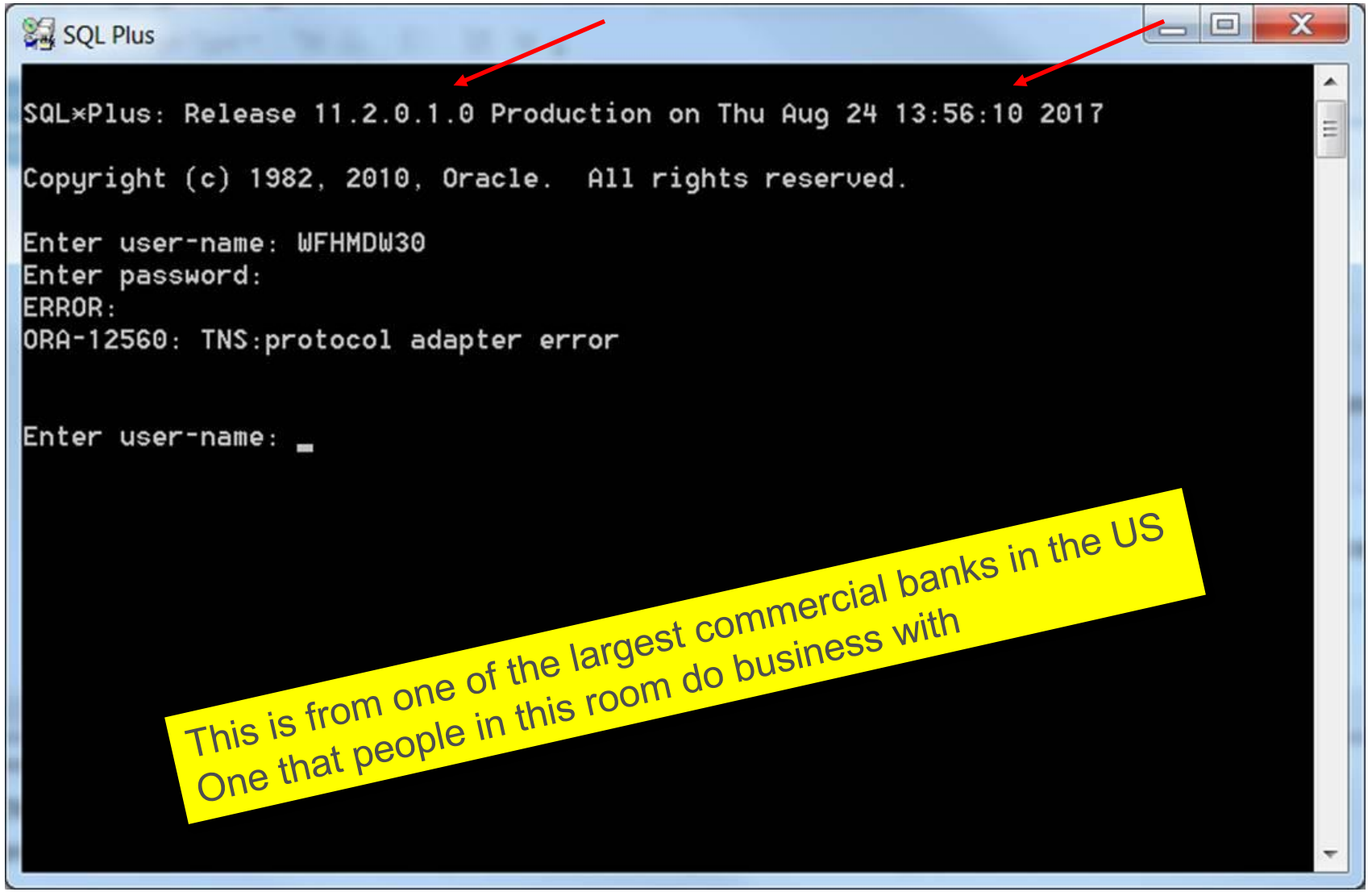
# VIP HOSTNAMES
192.0.2.20 orclsys1-vip.example.com orclsys1-vip
192.0.2.21 orclsys2-vip.example.com orclsys2-vip

# 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
```

Patching: A Risk Hiding In Plain Sight

As If It Was Required That I Further Emphasize The Point



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;
```

Startup Initialization Parameters

- 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_AUTHENT_PREFIX
  - 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

- 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.

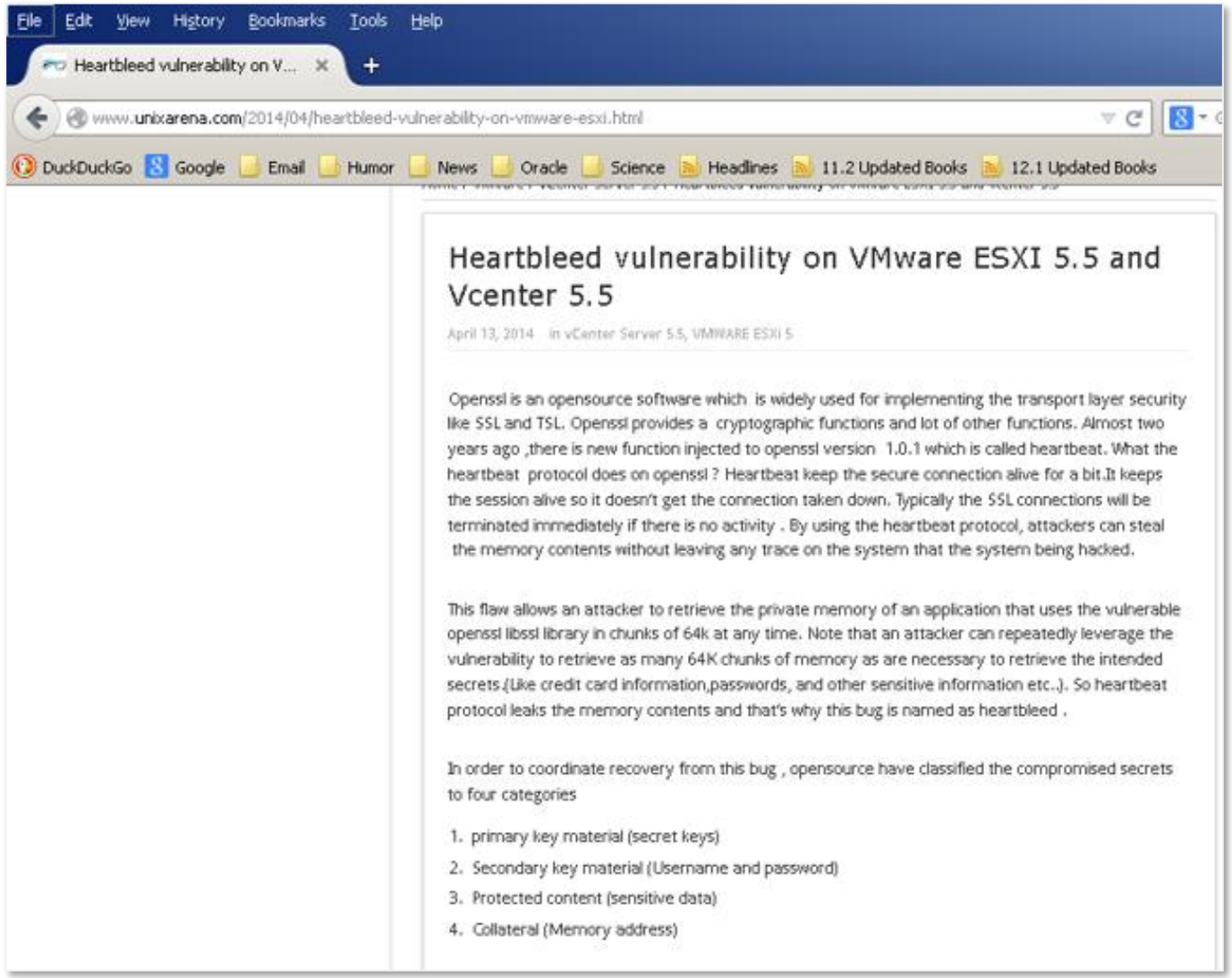
Action	`ALTER SYSTEM SET utl_file_dir=''`
	`COMMENT='Set to FALSE <date>'`
	`SID='*'`
	`SCOPE=SPFILE;`
	
	The database must be restarted for this change to take effect.
	
	Use CREATE DIRECTORY to create corresponding directory object(s) as required.

Storage

- The following are all locations commonly used to store data assets or information that can be used to compromise access to those assets
  - 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

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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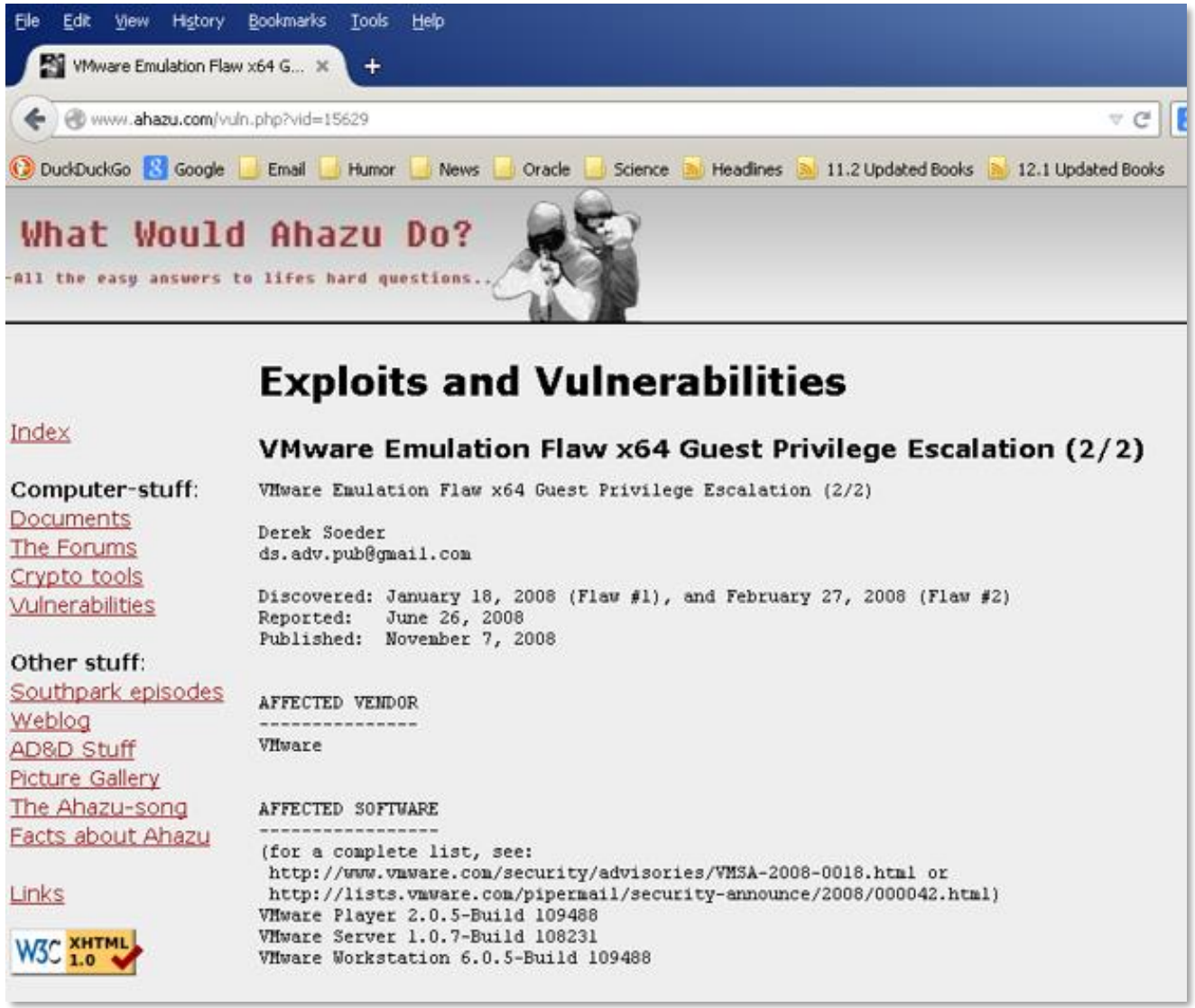
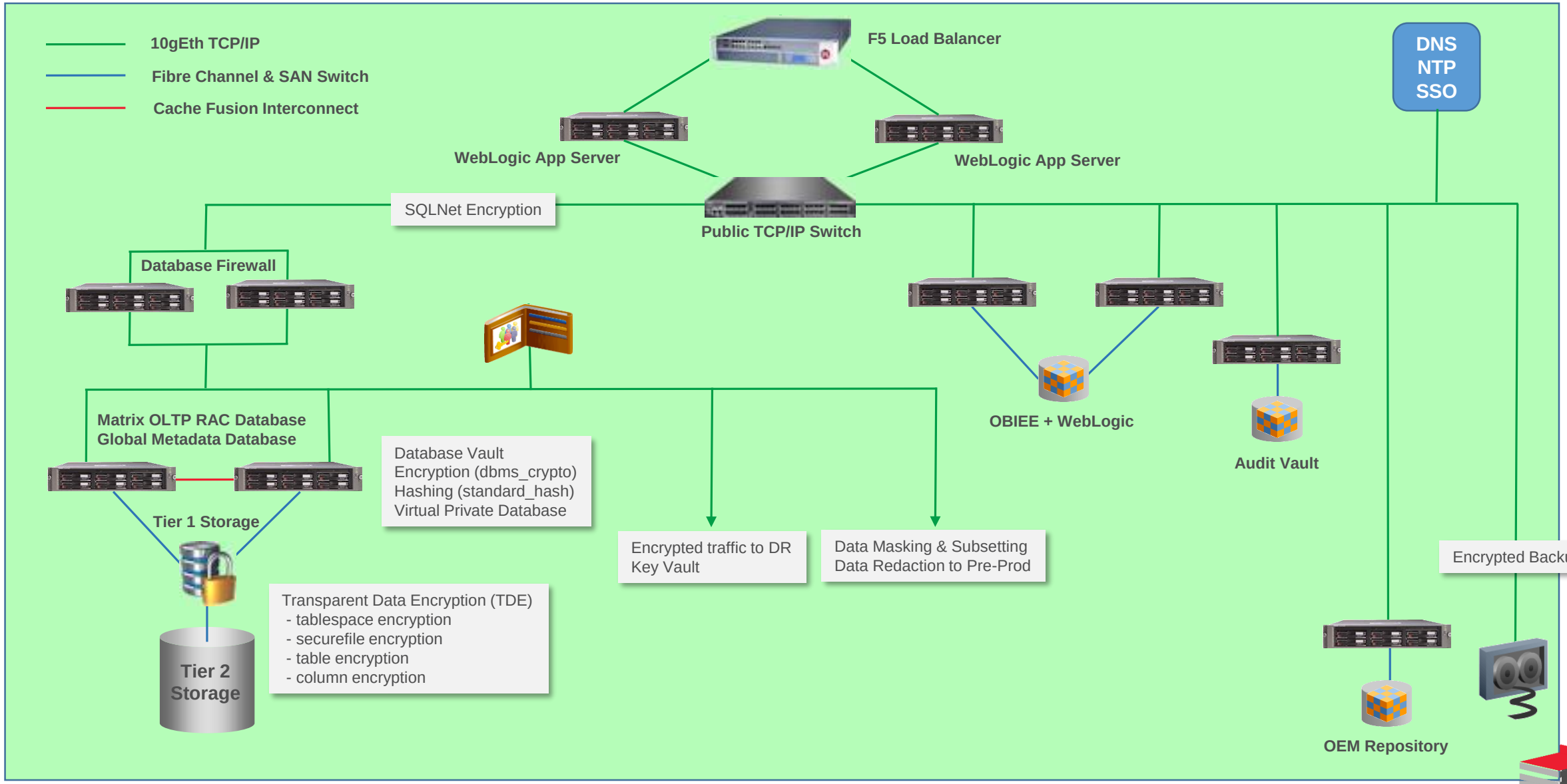
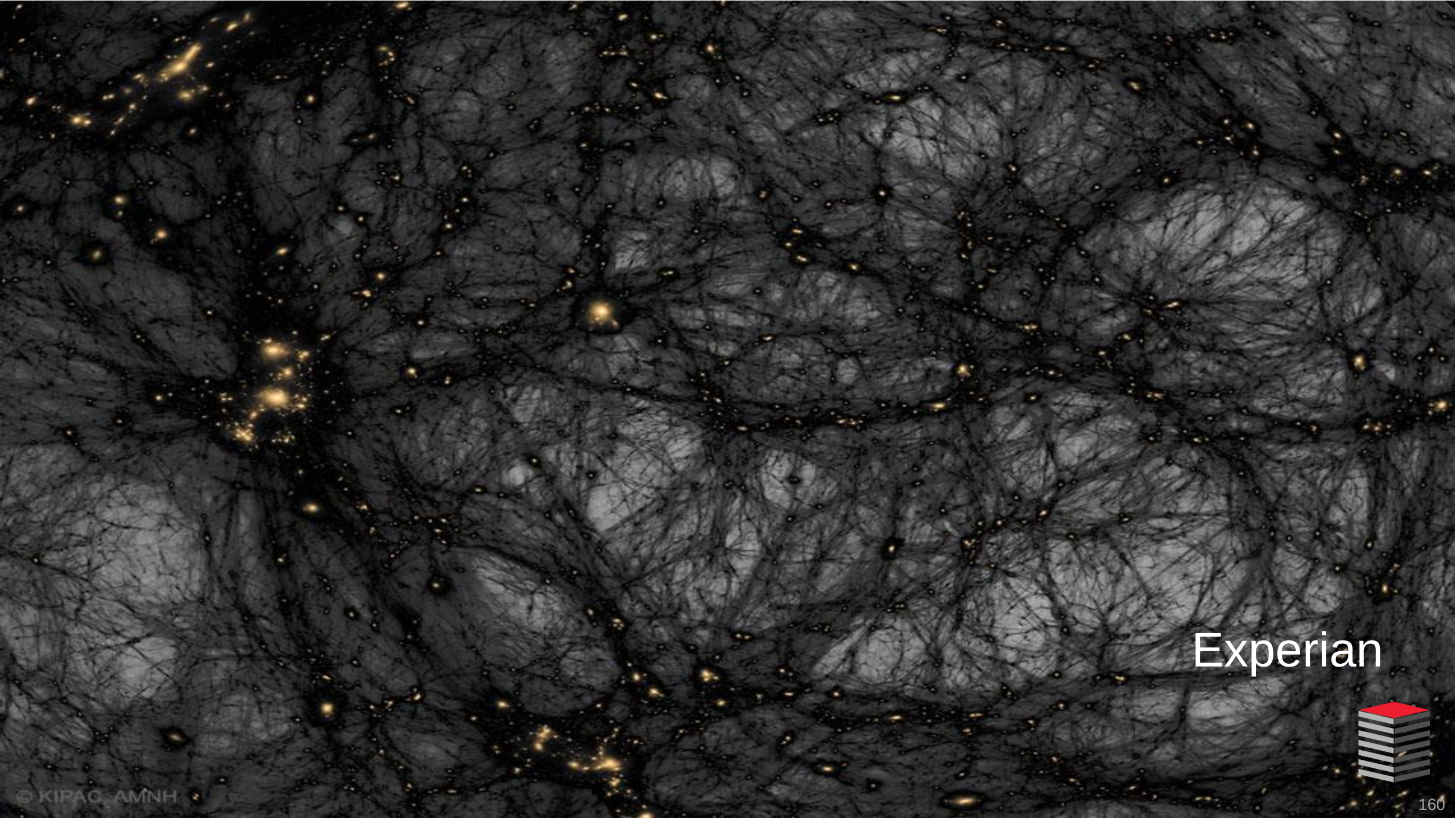


A Case Study

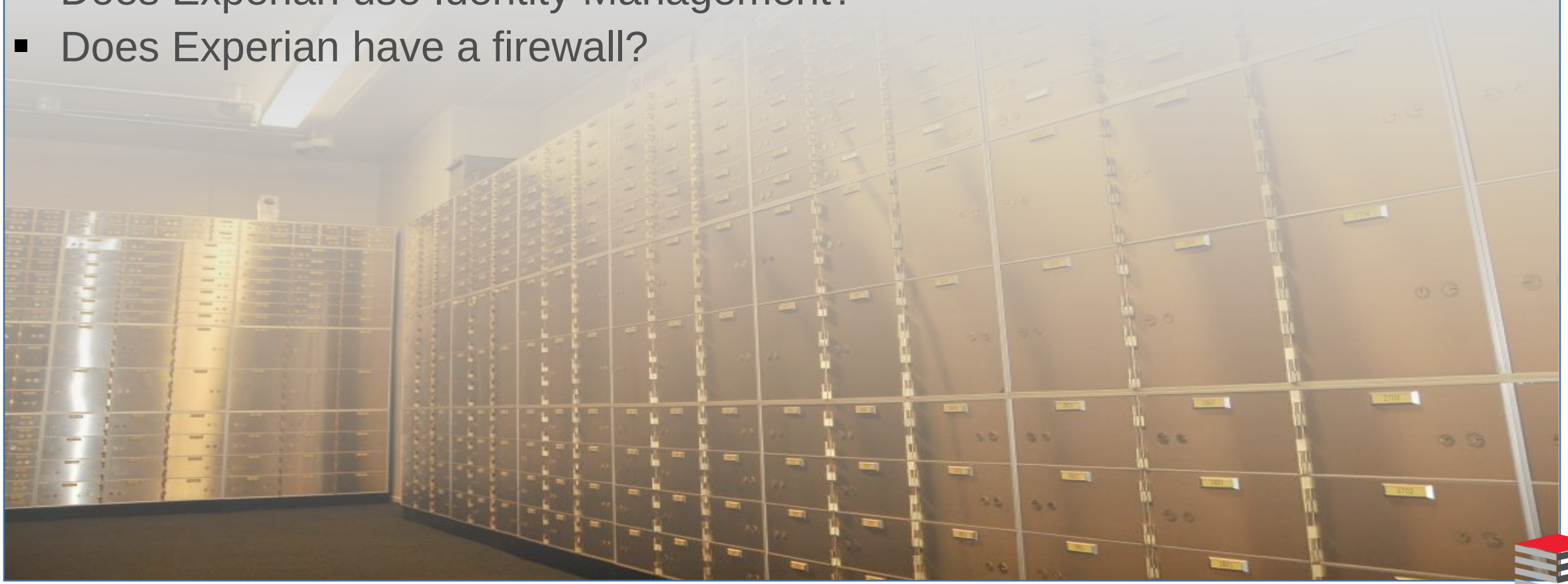
Example Minimum Environment




Experian
© KIPAC, AMNH

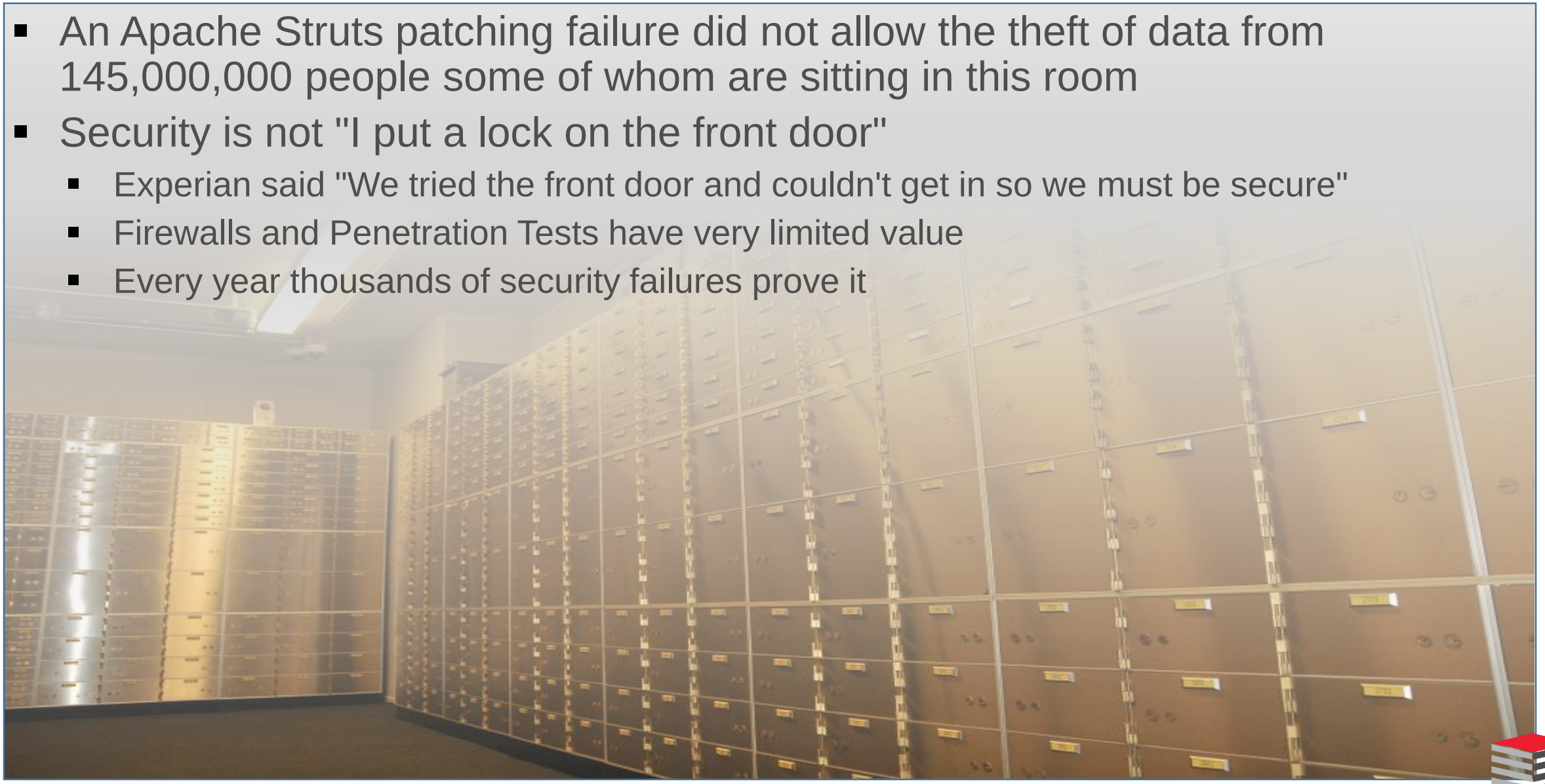
Are You The Next Experian?

- Do Experian employees need a valid userid and password to access data?
- Did Experian pass their Sarbanes-Oxley and PCI audits?
- Did Experian meet their internal governance rules?
- Does Experian use Identity Management?
- Does Experian have a firewall?



Are You The Next Experian?

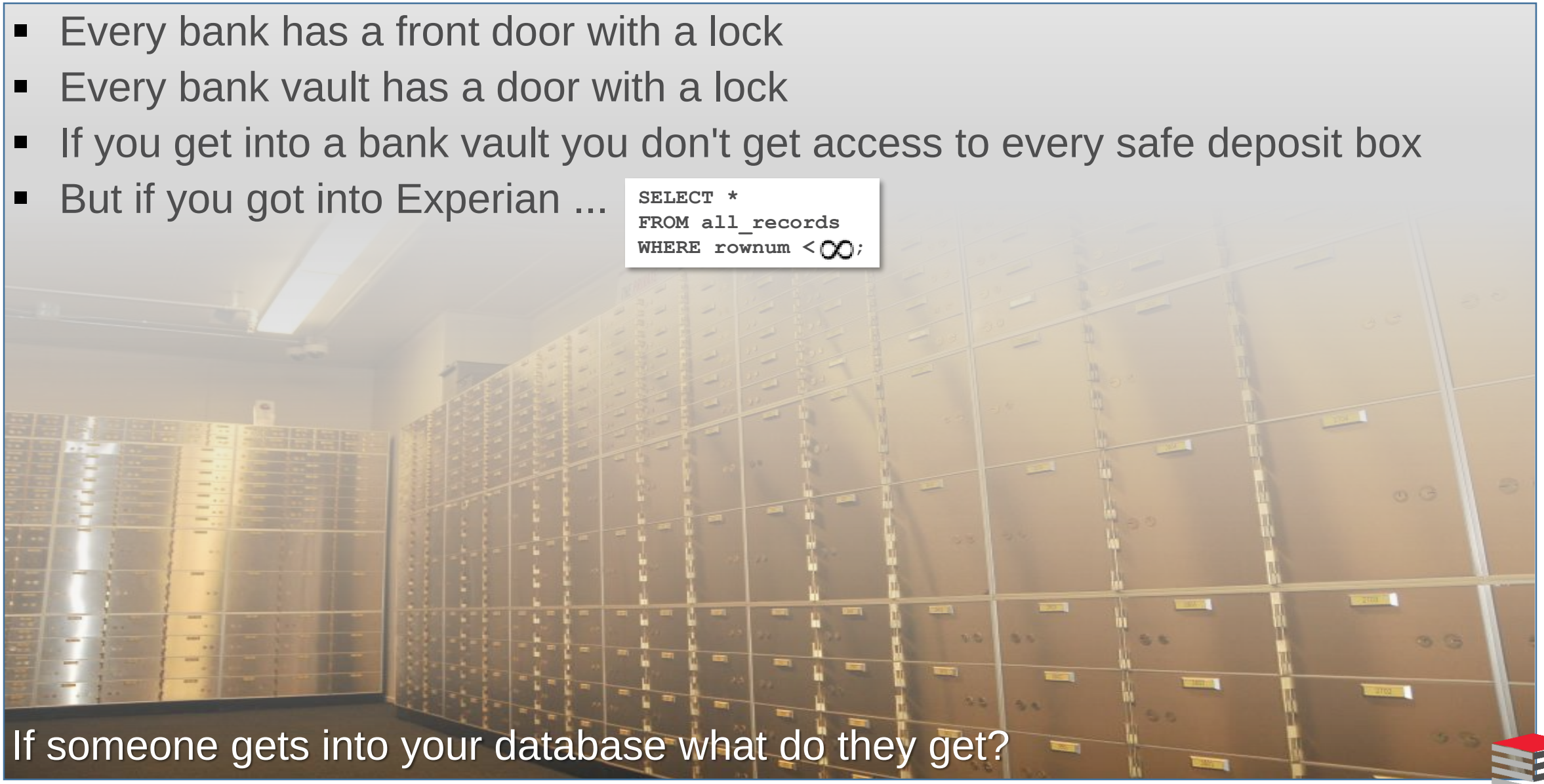
- An Apache Struts patching failure did not allow the theft of data from 145,000,000 people some of whom are sitting in this room
- Security is not "I put a lock on the front door"
  - Experian said "We tried the front door and couldn't get in so we must be secure"
  - Firewalls and Penetration Tests have very limited value
  - Every year thousands of security failures prove it



Are You The Next Experian?

- Every bank has a front door with a lock
- Every bank vault has a door with a lock
- If you get into a bank vault you don't get access to every safe deposit box
- But if you got into Experian ...

```
SELECT *
FROM all_records
WHERE rownum <∞;
```



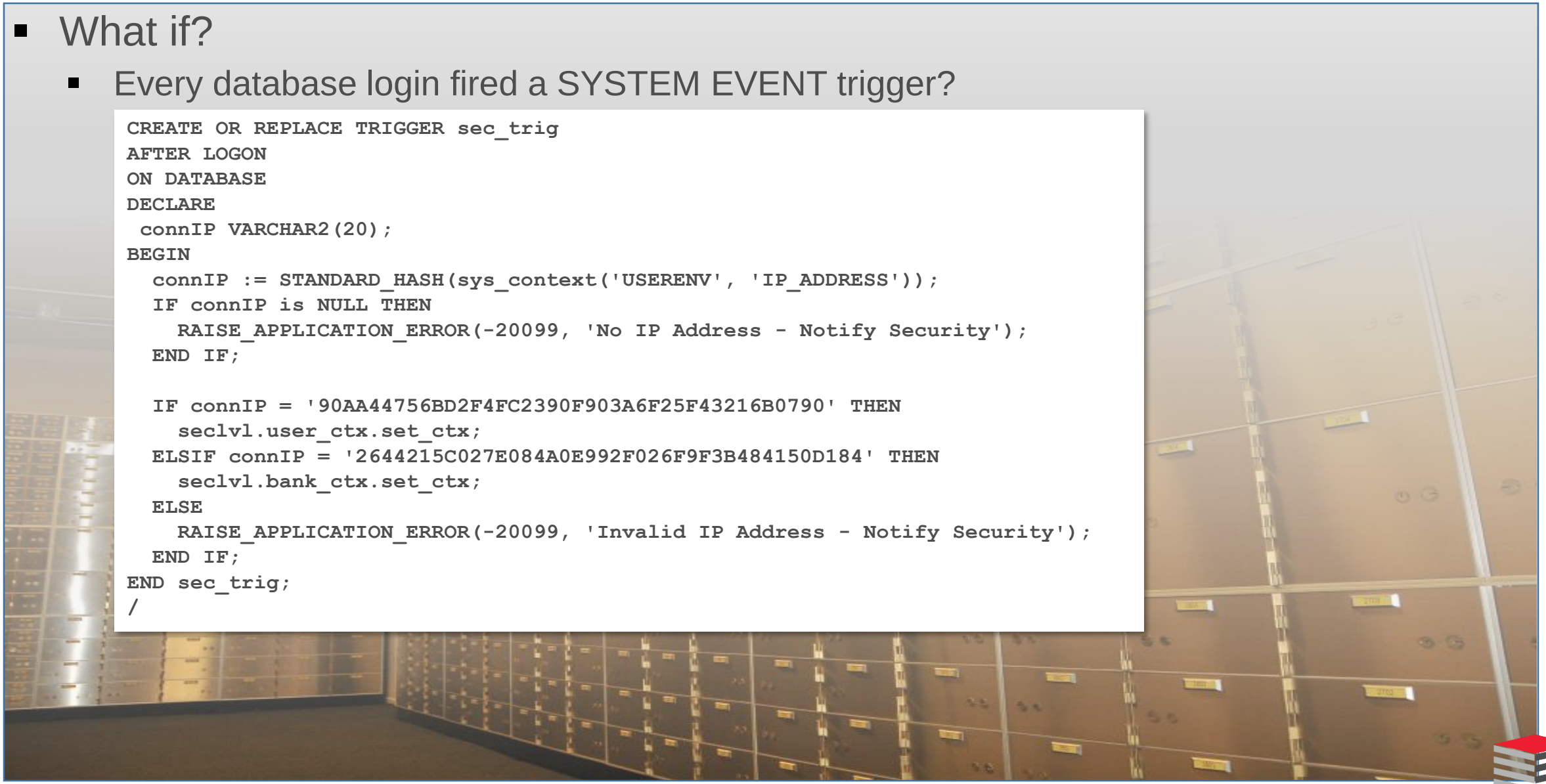
If someone gets into your database what do they get?

Are You The Next Experian?

- What if?
  - Every database login fired a SYSTEM EVENT trigger?

```
CREATE OR REPLACE TRIGGER sec_trig
AFTER LOGON
ON DATABASE
DECLARE
 connIP VARCHAR2(20);
BEGIN
  connIP := STANDARD_HASH(sys_context('USERENV', 'IP_ADDRESS'));
  IF connIP is NULL THEN
    RAISE_APPLICATION_ERROR(-20099, 'No IP Address - Notify Security');
  END IF;

  IF connIP = '90AA44756BD2F4FC2390F903A6F25F43216B0790' THEN
    seclvl.user_ctx.set_ctx;
  ELSIF connIP = '2644215C027E084A0E992F026F9F3B484150D184' THEN
    seclvl.bank_ctx.set_ctx;
  ELSE
    RAISE_APPLICATION_ERROR(-20099, 'Invalid IP Address - Notify Security');
  END IF;
END sec_trig;
/
```



Are You The Next Experian?

- And every user access had an Row Level Security policy?

```
exec dbms_rls.add_policy(USER, 'CREDIT_RPT_VIEW', 'USER_VIEW_POLICY', USER, 'credit_sec.user_sec', 'SELECT');
exec dbms_rls.add_policy(USER, 'CREDIT_RPT_VIEW', 'BANK_VIEW_POLICY', USER, 'credit_sec.bank_sec', 'SELECT');
```

- And every access request was row limited by the context?

```
CREATE OR REPLACE PACKAGE credit_sec AS
 FUNCTION user_sec(owner VARCHAR2, objname VARCHAR2) RETURN VARCHAR2;
 FUNCTION bank_sec(owner VARCHAR2, objname VARCHAR2) RETURN VARCHAR2;
END credit_sec;
/
```

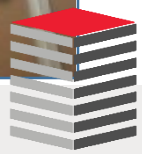
- And the user_sec function did this

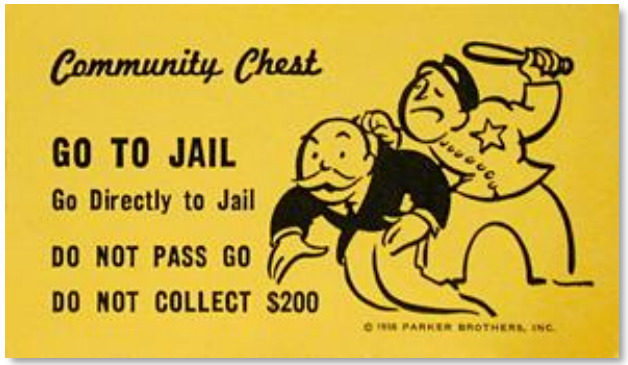
```
IF (sys_context('credit_rpt', 'user_role') = 'USER') THEN
   predicate := 'rownum <= 1';
 ELSE
   predicate := '1 = 2';
 END IF;
 RETURN predicate;
```

- Or this

```
IF (sys_context('credit_rpt', 'user_role') = 'BANK') THEN
   predicate := 'rownum <= 10000';
 ELSE
   predicate := '1 = 2';
 END IF;
 RETURN predicate;
```

Could someone steal 145,000,000 rows?




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 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
```

Conclusions (1:2)

- Securing the Perimeter has proven that its primary value is to companies selling products that claim to secure the perimeter
- Auditing is not security
- Passing audits is not security
- 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 (APEX, JAVA, JavaScript, C#, Python, C++, PHP, Ruby)
  - 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
- To begin securing data we must utilize the Oracle Database's built-in features
- To fully secure data we must utilize additional tools many of which Oracle makes available and fully integrates into the Red Stack

Conclusions (2:2)

- 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 DBA "training" involves security
- Forsythe is the 2nd largest security integrator in North America and the Meta7 team extends Forsythe's expertise in the area of securing data and databases

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

Thank you