Misconfigured By Default

Installing the Oracle Database for Expert Oracle DBAs

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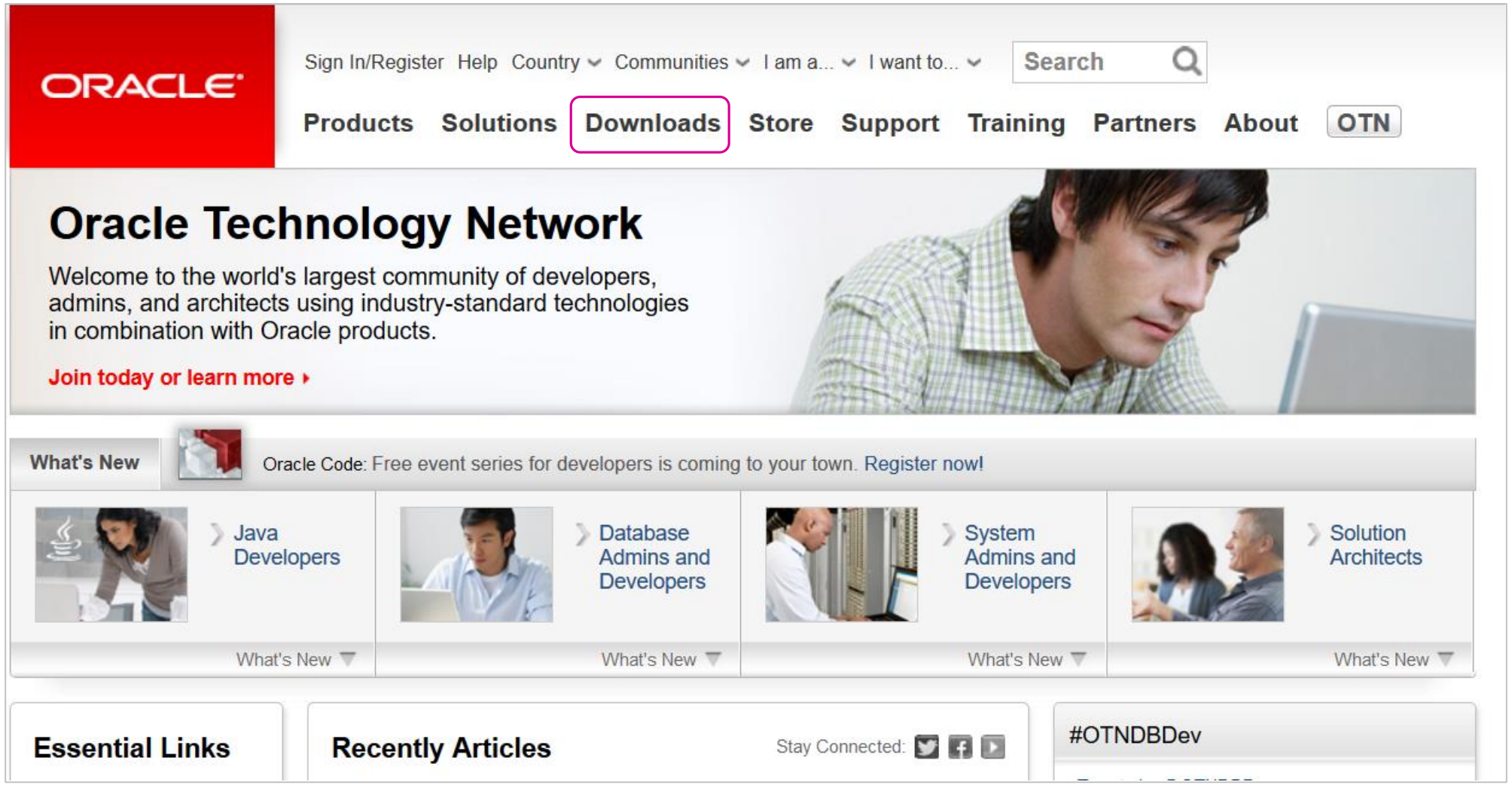
Unsafe Harbor

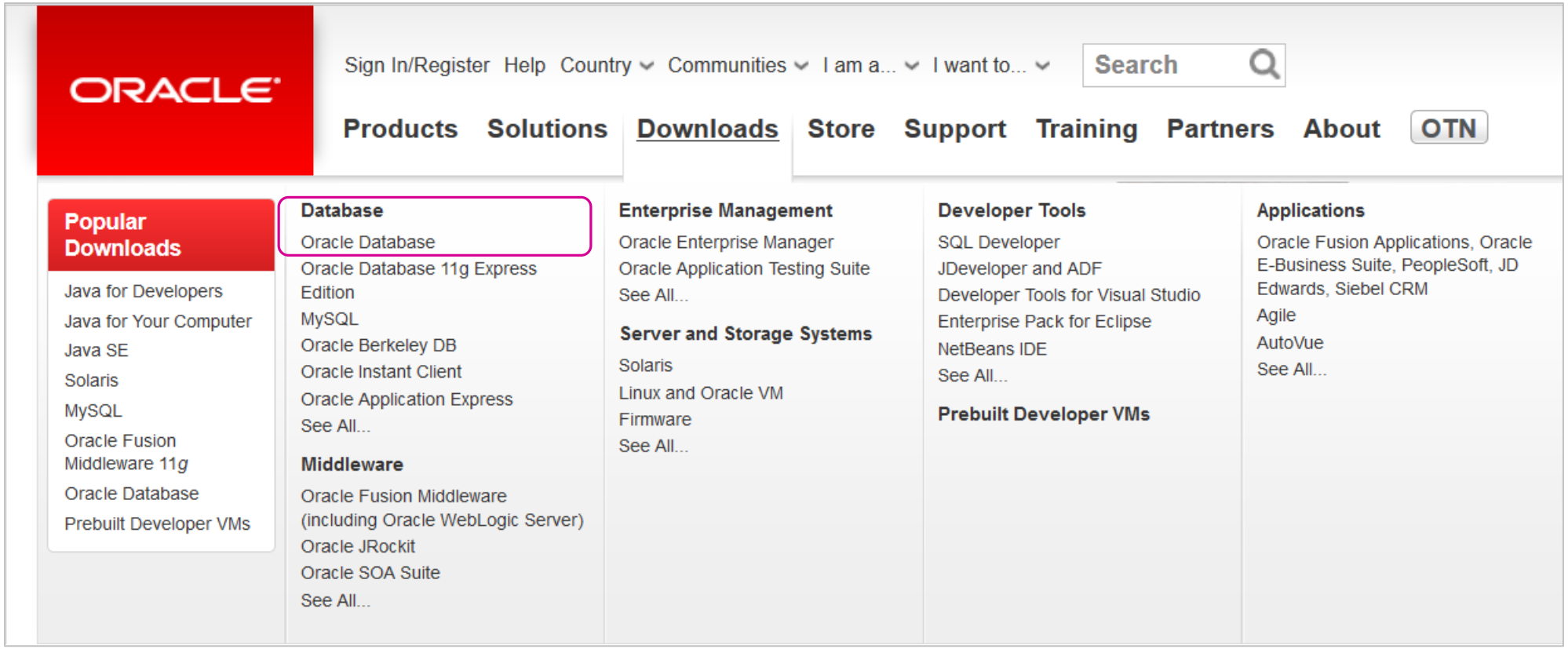
- This room is an unsafe harbor
- You can rely on the information in this presentation to help you protect your data, your databases, your organization, and your career
- No one from Oracle has previewed this presentation
- No one from Oracle knows what I'm going to say
- No one from Oracle has supplied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

Get Database 12.2 Today (1:3)



http://otn.oracle.com

Get Database 12.2 Today (2:3)



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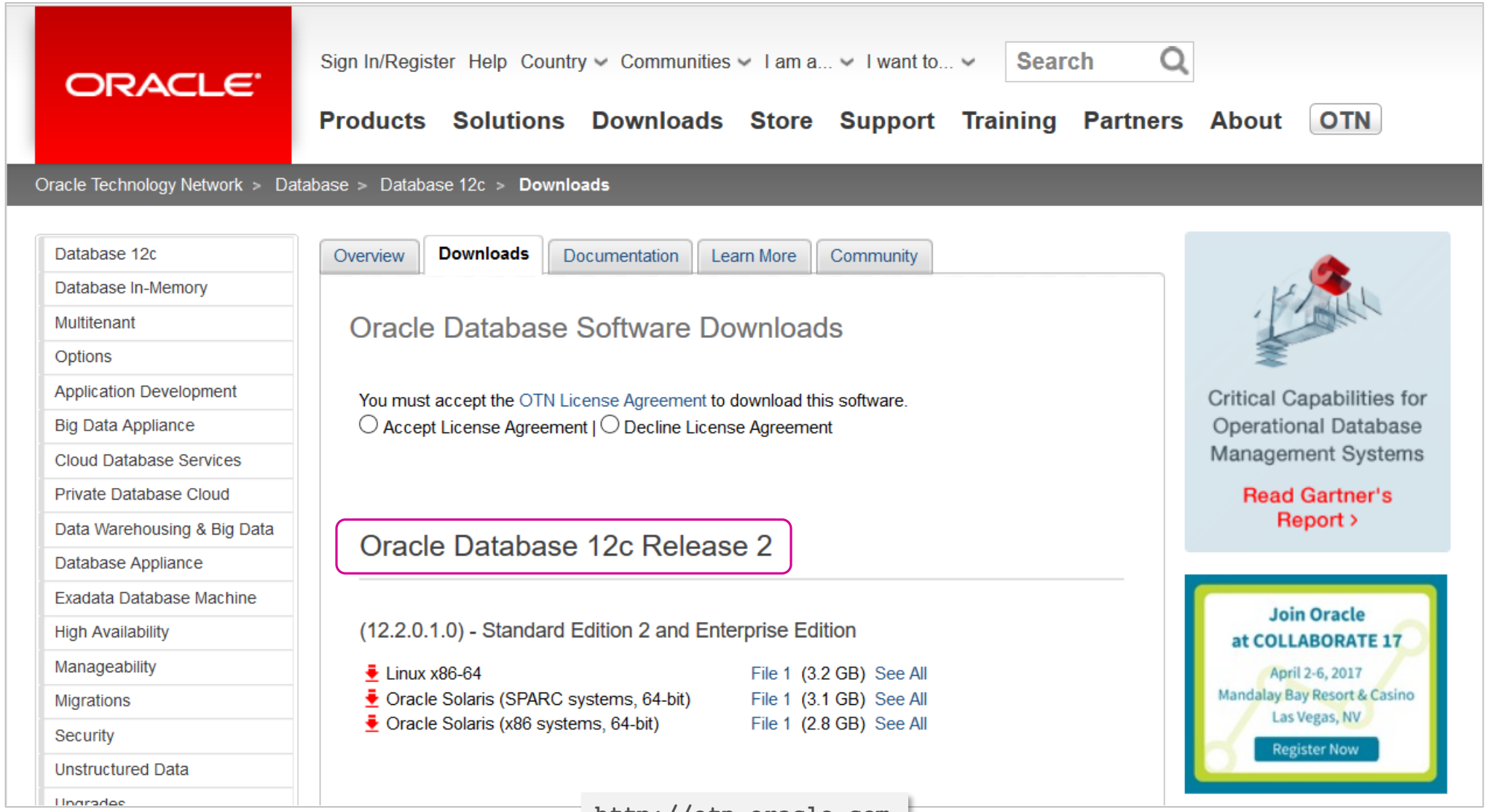
Get Database 12.2 Today (3:3)



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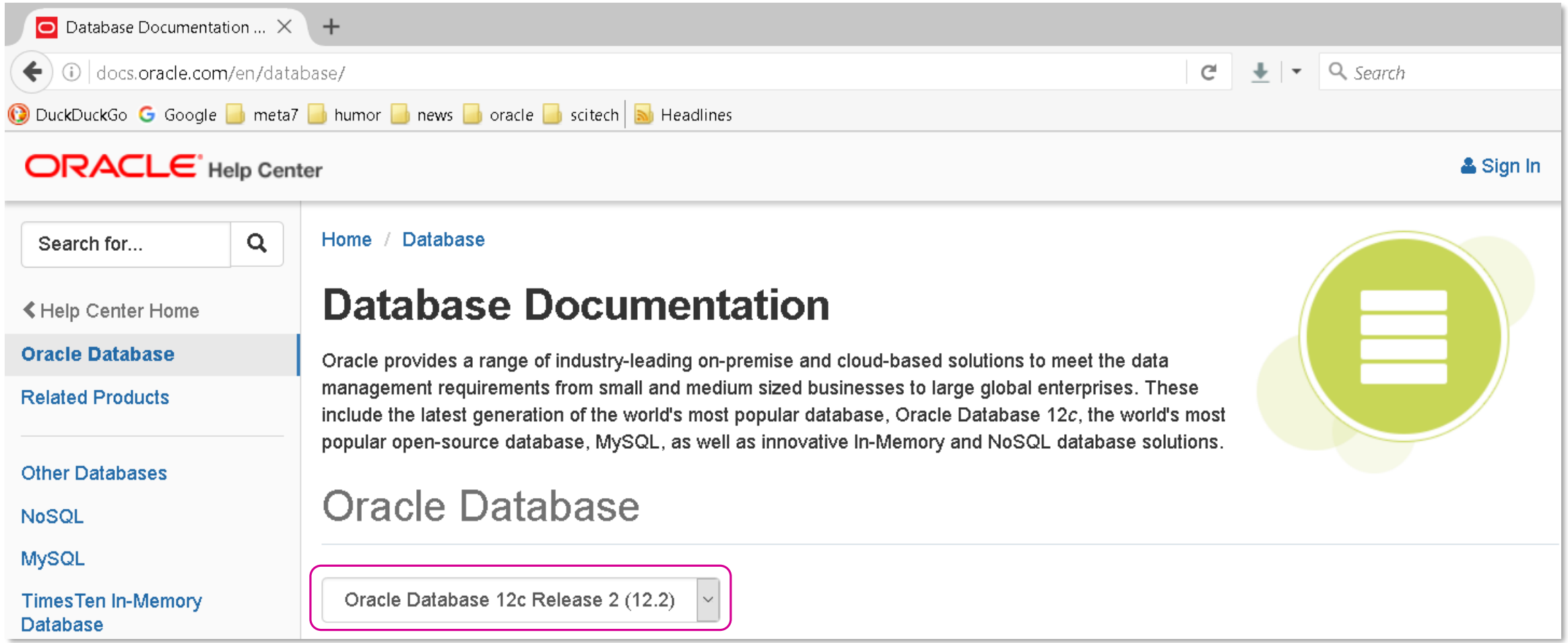
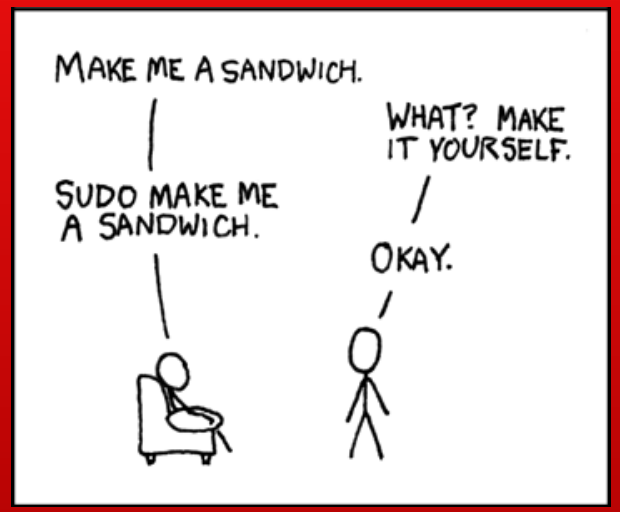
Get 12.2 Docs Today



`http://docs.oracle.com/en/database`



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 Latina de Panama and Technologico de Costa Rica
- IT Professional
  - First computer: IBM 360/40 in 1969: Fortran IV
  - Oracle Database since 1988-9
  - Beta Tester 10g, 11g, 12c, GoldenGate, TimesTen
  - The Morgan behind www.morganslibrary.org
  - Member Oracle Data Integration Solutions Partner Advisory Council
  - Co-Founder International GoldenGate Oracle Users Group
  - Vice President Twin Cities Oracle Users Group
- Principal Adviser: Forsythe **Meta7**

System/370-145 system console

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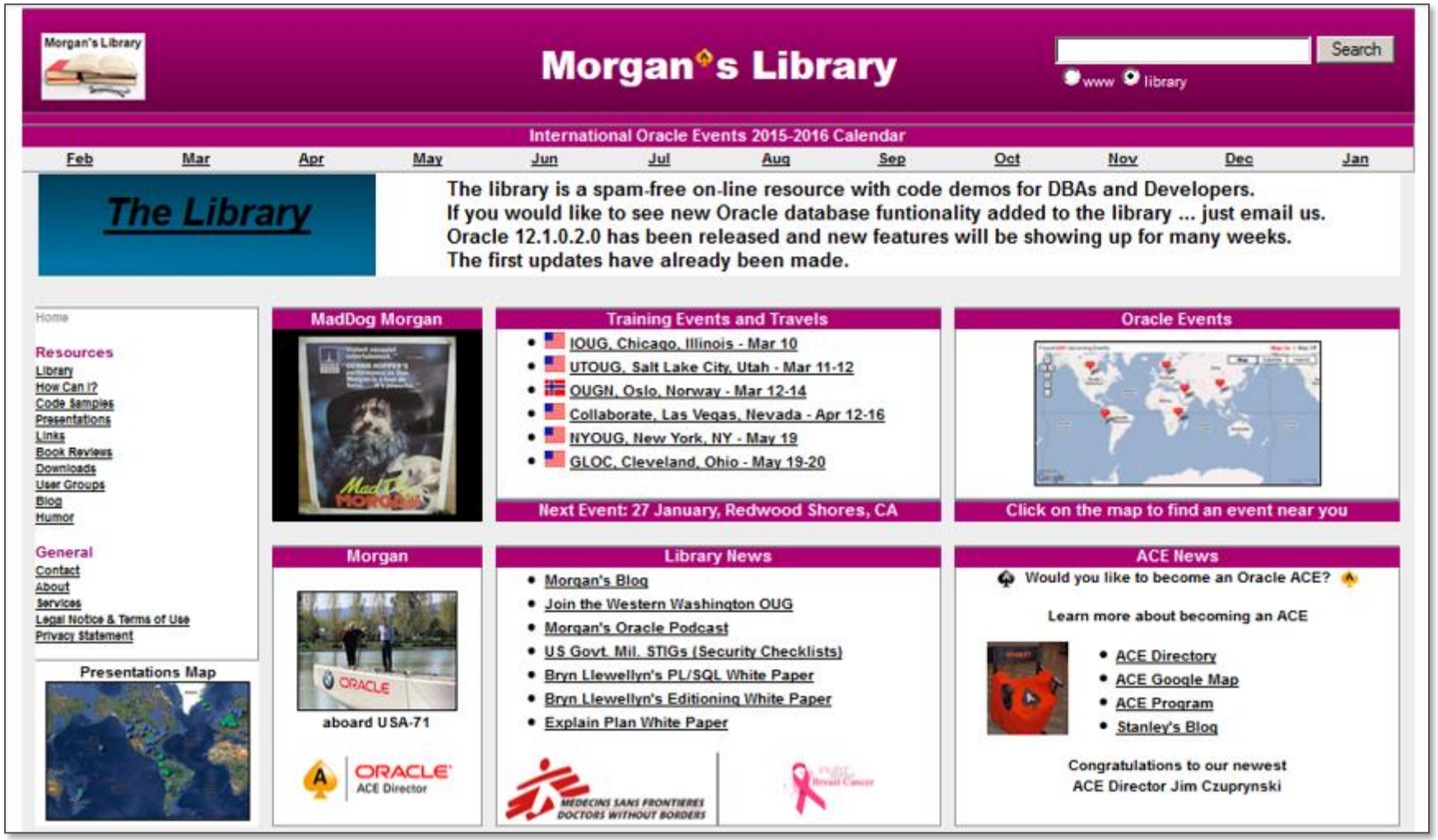

What Meta7 Brings To The Party

- The "Oracle Only" division of Forsythe
- A team of highly skilled professionals with
  - Extensive experience across multiple industries
  - Deep specialization in core Oracle technologies
    - Hardware
    - Licensing
    - Professional Services
  - 0% off-shore: All work performed by US residents
  - $1M+ investment in the Oracle Cloud
- Reliable on-time and on-budget delivery
- Second largest security integrator in North America
- Corporate headquarters in Chicago, Illinois
- New, State-of-the-Art Technology Evaluation Center
- Flexible financial support

ORACLE Platinum Partner

Zero Downtime Migration

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Safeguarding Databases From Cyber Threats

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Scaling VLDBs

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Database Performance

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Fire Fighting

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Cloud Migration

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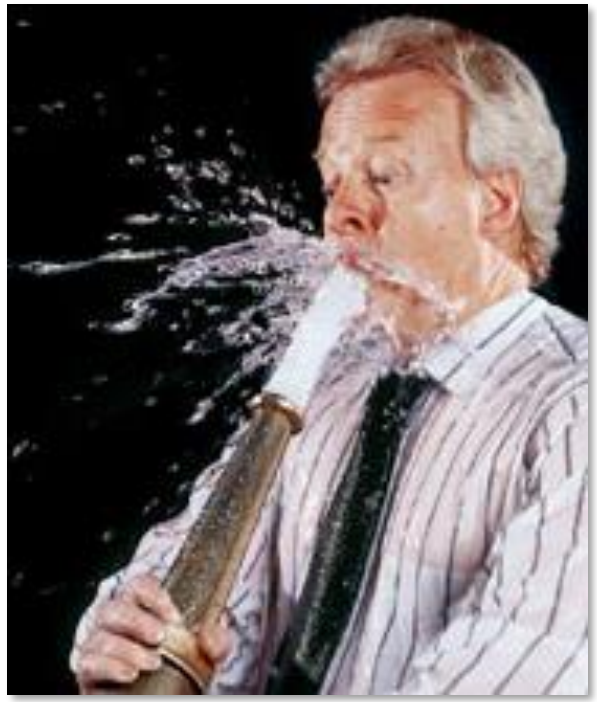
Content Density Warning

Take Notes ... Ask Questions



Rhetorical Question

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

- Then why are you installing the Oracle Database the way you did in the 90's?

Why Am I Focusing On Oracle Database Installation?

- Because no one else is
- Because Oracle University doesn't teach this material
- Because essentially no-one does a good job of Oracle Database installation
- Because we have now spent 37 years installing it and we still have issues with the three S's
  - Stability
  - Security
  - Scalability
- Because OUI and DBCA do a mediocre job of database installation
- Because it does not take talent to type `./runInstaller` then click `[Next]`
- Because we, as an industry, need to stop implementing and accepting mediocrity and rise to a more professional standard
- And if we can't then we are really making the best possible case, in the worse possible way, for moving everything to DBaaS

The Concept

- Simply put ... do it right during initial installation ... not incrementally over subsequent days, weeks, months, and years
- Getting it right during initial installation will eliminate years of fighting fires, security breaches, audit failures, and performance issues
- This means
  - Buy the right infrastructure
  - Properly configure the networks
  - Properly configure the storage
  - Properly configure the servers
  - Properly configure the operating system and any virtualization layer
  - Properly configure every aspect of the database
- And it means educating our network, storage, and system administrators on what constitutes "best practices"
  - I hope this won't frighten them too much but they have to read the docs

Célébrer La Différence (1:2)

- The biggest single difference between an OUI + DBCA installation and what is recommended here is addressing the inherent risk in using SQL*Plus in the $ORACLE_BASE file system which is an unacceptable security compromise
- Other than an extremely limited set of tasks there is no regular monitoring or maintenance job that requires operating system access as the owner of the Oracle binaries and the $ORACLE_BASE file system
- Anyone that can log in as the *NIX user oracle
  - Has the ability to own your database using "**`/ as sysdba`**"
  - Has access to the alert log
  - Has access to $ADR_HOME and can read diagnostics
  - Has access to the FRA
  - Has access to the listener and its configuration files
  - Has access to every script in **`/rdbms/admin`**
  - Likely also can read RMAN, Export, Import, and shell scripts
- If people have this level of access security is essentially impossible to achieve

Célébrer La Différence (2:2)

- Thus, it is strongly recommended, that an Oracle Database installation
- Unless it will store nothing more important than my mother's cookie recipes
- Involve creation of two separate owner's for Oracle binaries
  - $ORACLE_BASE for installation of the Oracle Database
  - $ORACLI_BASE for installation of the Oracle Client
- And a third owner if Oracle Clusterware and ASM are utilized
  - $GRID_BASE for installation of Oracle Clusterware and ASM

Database Installation Roadmap

1. Gather Requirements
2. Plan Networks, Storage, Servers & Operating Environment
3. Deploy VM and Operating System
4. Configure Operating System
5. Shell Configuration
6. Operating System Lockdown
7. Clusterware & DB Binary Installation
8. Listener Configuration
9. Database Installation
10. SPFILE Modification
11. GLOGIN Modification
12. Secure Database
13. Privilege Revocation
14. Get Optimizer Statistics
15. Get Processing Rates
16. Set AWR Collection
17. Create Tablespaces
18. Create Users

Database Client Installation Roadmap

1. Gather Requirements
2. Plan Networks, Storage. Servers & Operating Environment
3. Deploy VM and Operating System
4. Configure Operating System
5. **Shell Configuration**
6. Operating System Lockdown
7. **Client Installation**
8. Listener Configuration
9. Database Installation
10. SPFILE Modification
11. **GLOGIN Modification**
12. Secure Database
13. Privilege Revocation
14. Get Optimizer Statistics
15. Get Processing Rates
16. Set AWR Collection
17. Create Tablespaces
18. Create Users

The Basics

In The Beginning

- Before you purchase servers
- Before you purchase software licenses
- Before anything is racked-and-stacked
- Before downloading the installation zip files
- There are things that you must know to have any chance of getting it right
- This section addresses essential background information that you must possess and understand

Requirements

- You cannot make good decisions without knowing the answers to these questions
  - Service Level Agreement (SLA)
  - Recovery Point Objective (RPO)
  - Recovery Time Objective (RTO)
  - Cost, per minute/hour, of unplanned outage
  - Anticipated number of simultaneous connections and 3-5 year growth projection
  - Anticipated number of simultaneous transactions and 3-5 year growth projection
  - Anticipated storage footprint and 3-5 year growth projection
  - Anticipated interfaces by software, protocol, bandwidth, and latency
  - Internal governance requirements and how they will be achieved
  - External compliance requirements and how they will be achieved

Requirements

- If you cannot answer the preceding questions you cannot
  - Determine whether you need
    - One data center or three
    - x86-64 or z-Series frame ... ODA or Exadata ... T7 or SuperCluster or M10
    - Express, SE2, Standard or Enterprise Edition
    - High Availability options such as RAC and Data Guard
    - Active Data Guard licensing
    - Advanced Compression Option
    - Security Options such as Database Vault, Advanced Security, Label Security
    - Multitenant Option
    - In-Memory Option
    - Diagnostic and Tuning Pack
  - Whether licensing should be based on cpu cores or named users
  - Whether licensing should be perpetual or time limited

Networks (1:2)

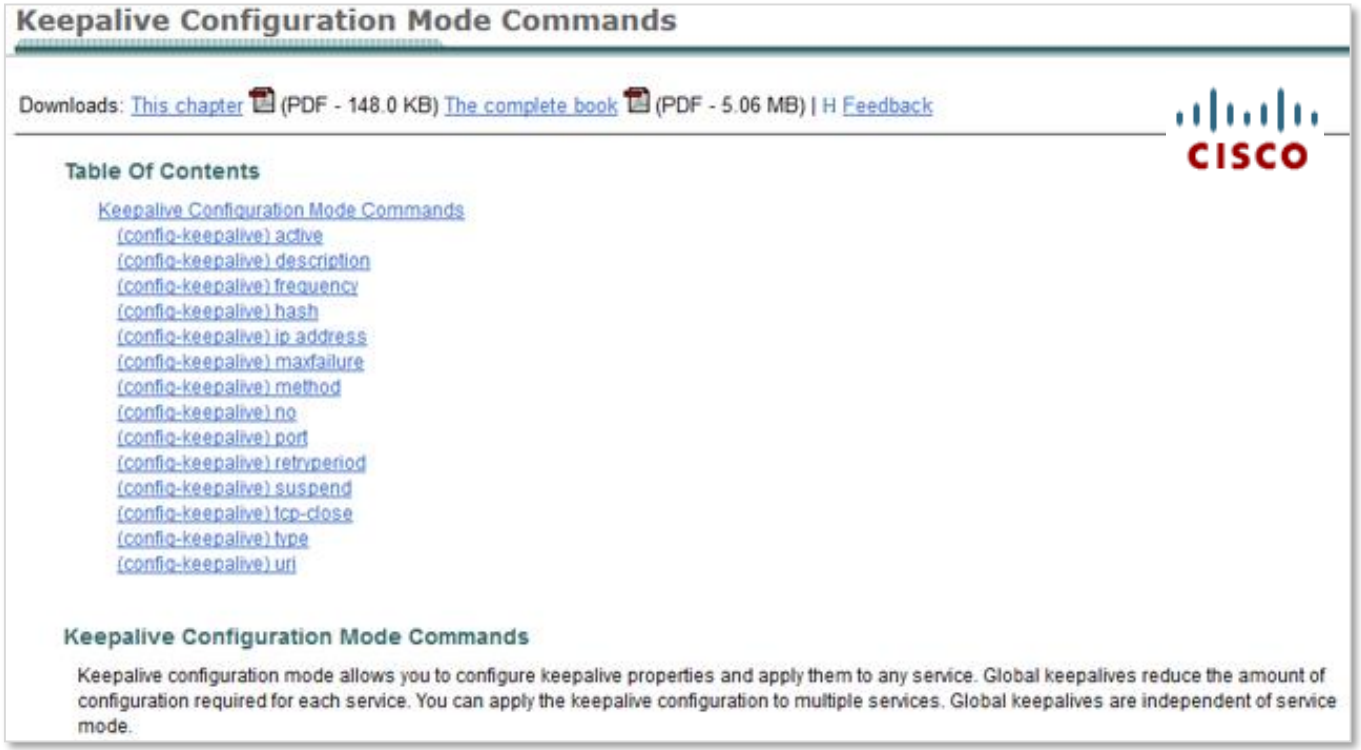
- Every Oracle Database deployment may require multiple network connections: Here is a full listing

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

- If you wish to avoid single points of failure while deploying RAC and Data Guard in accordance with "best practice" guidelines ... there is a lot of network planning that needs to take place
- And no conversation of networking is complete without considering Firewalls DNS, and NTP (time) Servers

Networks (2:2)

- NIC cards should support
  - For both stand-alone and RAC
    - TCP Segmentation Offloading (TSO)
    - Allows the system to do TCP segmentation in the NIC driver instead of main CPU via the kernel



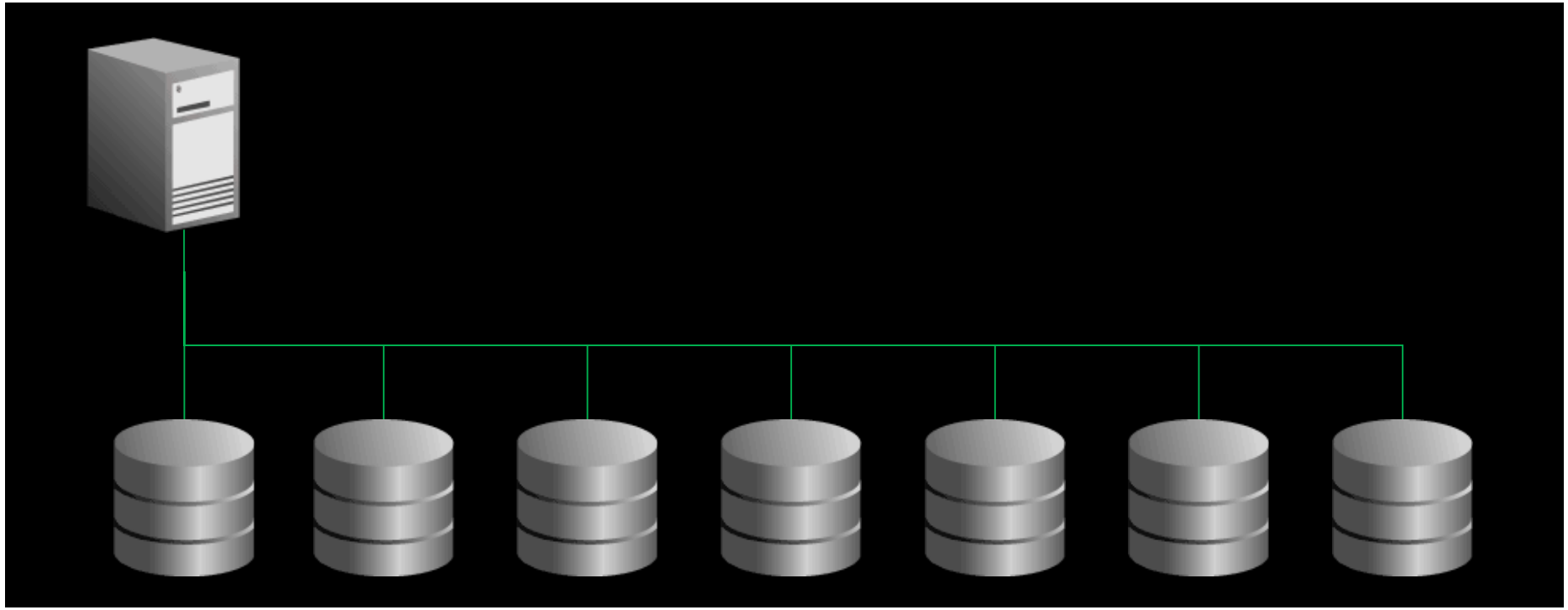
  - RAC
    - Configurable "keep-alive"
      - If a connection won't die immediately and cleanly it will never perform a transparent failover
    - Jumbo Frames (for the Cache Fusion Interconnect if 10gEth)
      - The normal frame size is 1518 bytes which must include the Layer 2 header and frame check sequence
      - To pass an 8K block without Jumbo Frames requires breaking the packet up into 5 pieces at the source and reassembling them at the target
      - As UDP packets are not sent in sequence additional read and write buffering is also required
      - Lost or flushed packets can result in a RAC node shooting itself in the head

Storage (1:2)

- Every Oracle Database deployment requires far more thought than just assigning a specified number of GB or TB to a LUN or Disk Group
- Let's explore some of those considerations
  - Amount of physical space that must be allocated at the time of deployment
  - The anticipated growth/shrinkage of the space requirement over time
  - The type of storage to be used: DASD, SAN, NAS
  - The speed and type of storage media
  - If shared storage the other storage tenants and their load profiles
  - File system or ASM
    - If a file system ... which one?
  - Will thin or thick provisioning be used?
  - Will "Snap & Clone" capabilities be in use?
  - Will storage device be encryption utilized?
  - Will storage device compression be utilized?
  - Will Direct and/or Asynch I/O be used?
  - The tool(s) that will be used to allocate and manage database storage

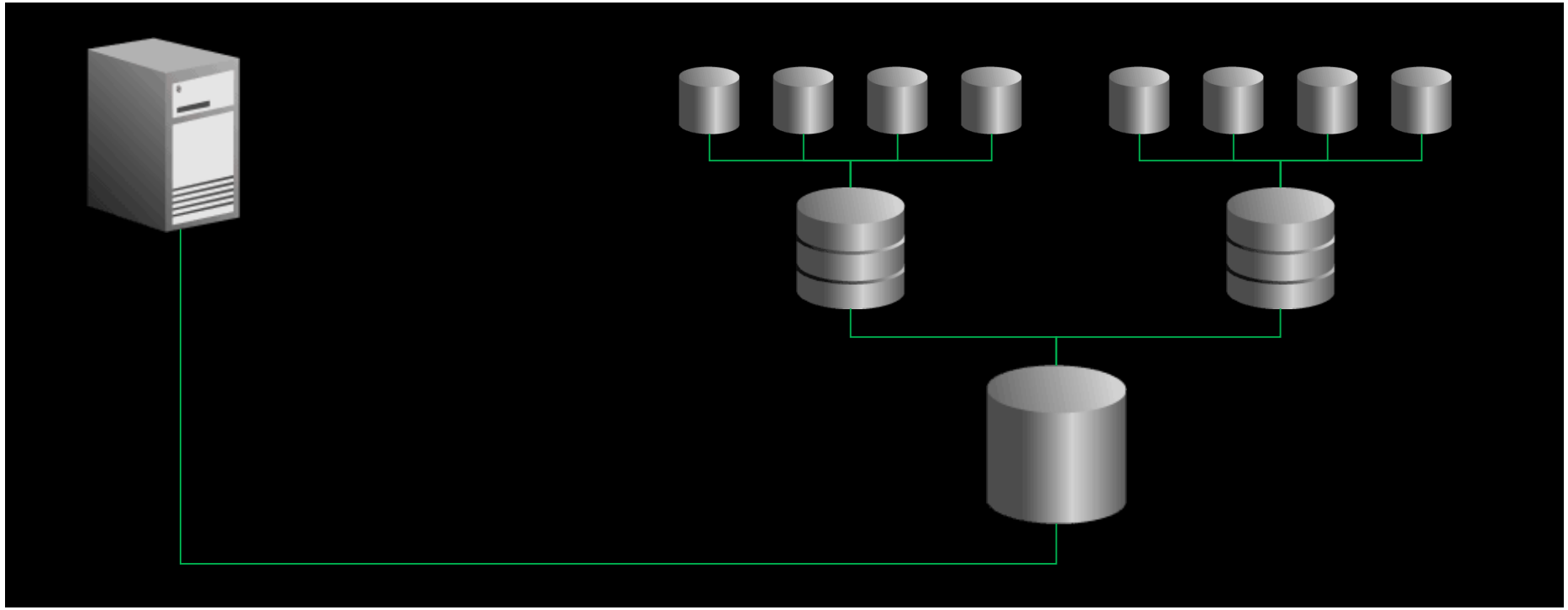
Direct Attached Storage (DASD / JBOD)

- Drive directly attached via copper SCSI, Fibre SCSI, or infiniBand
- Least expensive and least flexible storage



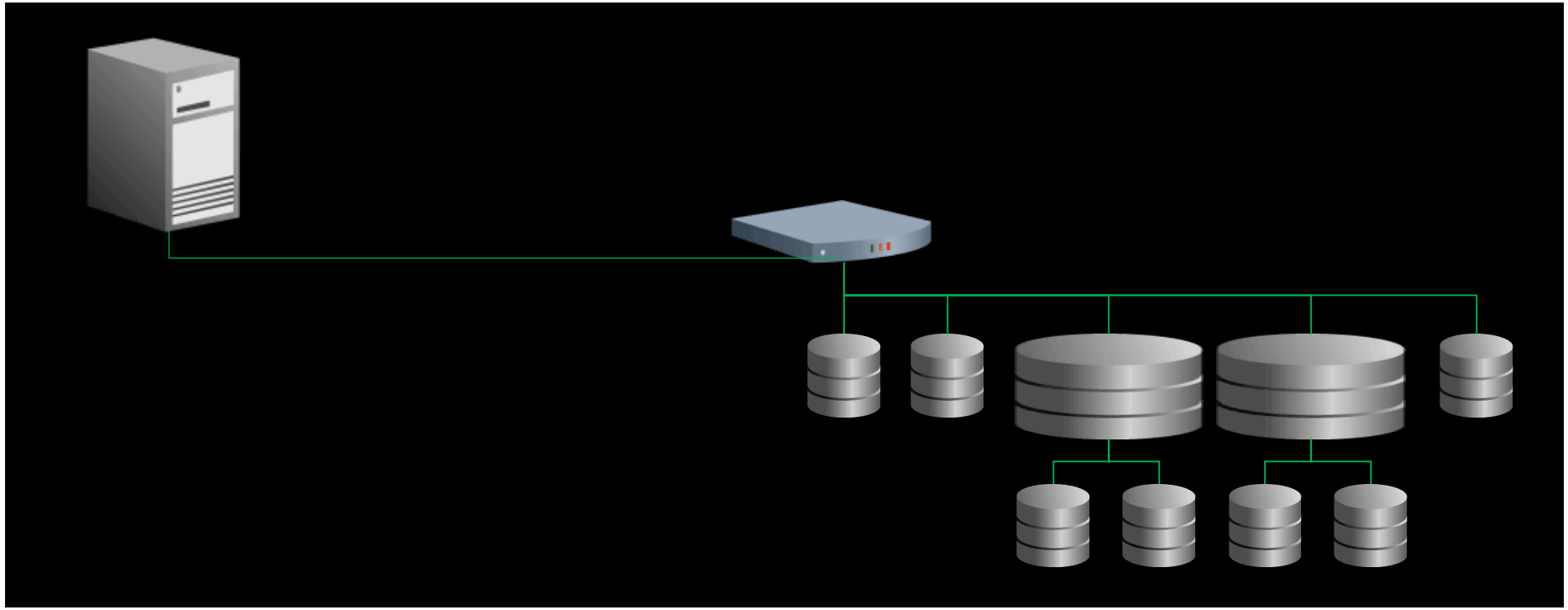
Network Attached Storage (NAS)

- Separate devices attached to servers by TCP/IP Network or infiniBand
- Simple and Flexible



Storage Area Network (SAN)

- Requires HBA (Host Bus Adapters) in each server
- Requires fabric switches
- Most expensive approach



Storage (2:2)

- The following is strongly recommended
  - DASD ... this is what all high-performance engineered systems choose ...it is fastest and least expensive
  - Do not share storage with non-Oracle database loads
  - Purchase a mixture of drive types: Solid State, High Performance, and High Capacity with storage tiering so that the fastest and most expensive storage is allocated where required and the least expensive storage is utilized for legacy data
    - Be sure you understand how to utilize Oracle Automatic Data Optimization (ADO), Heap Maps, and Partitioning
  - Use thin provisioning ONLY it will be utilized to allow for dynamic space allocation
    - Never use thin provisioning for the purpose of allocating a single volume of space in a way that, in effect, pretends more space exists than is real
  - Use ASM
  - Do not use Snap & Clone ... replicates valid or corrupt blocks at the same high speed
  - Do not utilize hardware-based storage compression
  - Carefully test all scenarios before utilizing hardware-based storage encryption

Servers

- Blades are not an appropriate infrastructure for Oracle Databases
- Blades are an unstable infrastructure for Oracle RAC
- What matters most in choosing servers
  - Component quality
  - Bus speed
  - Sufficient cpu cores and threads
  - A chipset that includes Oracle Database routines burned into the silicon
  - Sufficient memory
  - SNMP vs NUMA architecture
  - Slots sufficient to allow for redundant communications to all networks
  - Redundant power supplies
  - Hot-swappable components
  - A support organization that has a solid track-record supporting Oracle databases

Virtualized Environments & Operating Systems

Virtualized Environments (1:3)

- Reasons for VMs
  - Create protected environments
  - Run multiple operating system environments on the same physical server
  - Leverage hardware models such as "Capacity on Demand" and "Pay as you Grow"
  - Control resource allocation
    - Manage processor allocation between platforms and users
  - Control licensing costs
    - Two types of partitioning
      - Soft Partitioning
        - Virtually segments a server
        - Not recognized by Oracle Database licensing
      - Hard Partitioning
        - Physically segments a server
        - Recognized by Oracle Database licensing

Virtualized Environments (2:3)

OEM	Product	Description	License Recognition
Apache	Docker	Container ... both IBM and Oracle are making big investments into this technology	Not Determined
Fujitsu	PPAR		Yes
IBM	DLPAR	Container	Yes
IBM	Integrity Virtual Machine		Yes
IBM	LPAR		Yes
IBM	Micro-partitions	Capped Partitions only	Yes
IBM	nPar		Yes
IBM	Power VM Live		No
IBM	Secure Resource Partitions	Capped Partitions only	Yes
IBM	vPar	Container	Yes
Microsoft	Virtual PC	Hosted Virtualization	No
Oracle	Solaris Containers	Container	Yes
Oracle	Solaris LDOM	Container	Yes
Oracle	Solaris Zones	Container: Hard Partitions only	Yes
Oracle	Virtual Machine	Bare Metal Virtualization: Soft Partitioned	No
Oracle	Virtual Machine	Bare Metal Virtualization: Hard Partitions only	Yes
VMWare	ESX	Bare Metal Virtualization	No
VMWare	Workstation	Hosted Virtualization	No

Virtualized Environments (3:3)

- Reasons to **NOT** use VMs
- Oracle always recognizes hard partitioning
- Oracle never recognizes soft partitioning
  - Even when the soft partitioning is done with its own products like OVM and Solaris
- It is not Oracle's problem that VMware does not provide hard partitioning
- It is not Oracle's problem that some people selling soft partitioning either don't understand the difference or don't have an issue misrepresenting their products to their customers

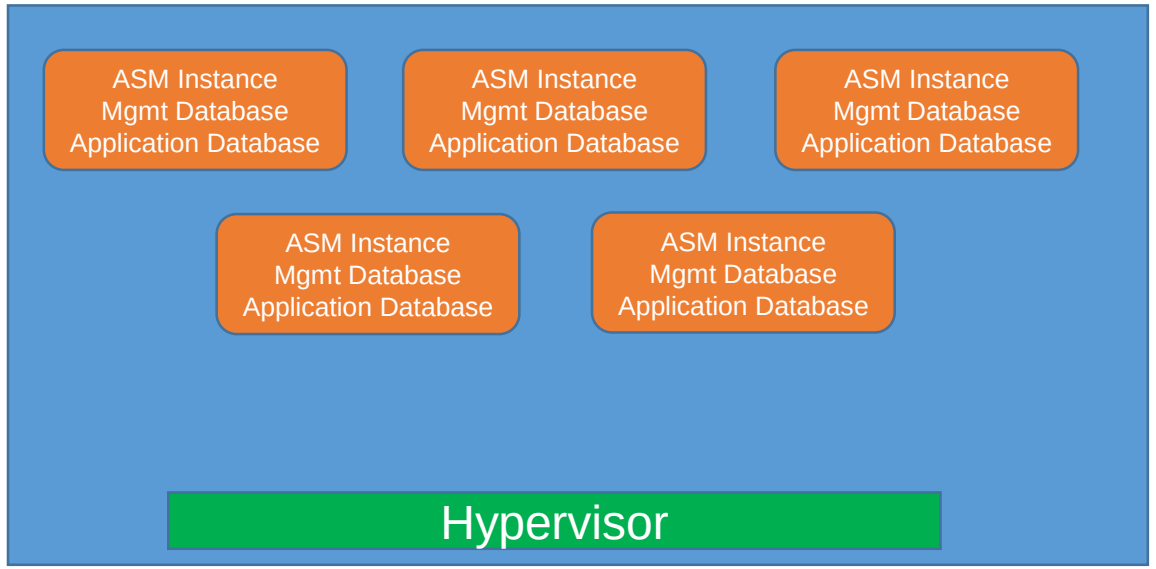
- All partitioning
  - Reduce available memory
  - Reduces available cpu
  - Increases complexity
  - May remove Oracle optimizations that talk directly to hardware such as ASM, Asynch I/O, Direct I/O, Compression on Silicon, and Encryption on Silicon

Friends don't let friends run Oracle Production Databases in VMware

- What you lose with VMware
  - Optimizations whereby Oracle bypasses the O/S and talks directly to the infrastructure
  - Oracle database code written into silicon
  - cpu and memory resources
  - ASM
  - $

Oracle In VM ... Do The Math

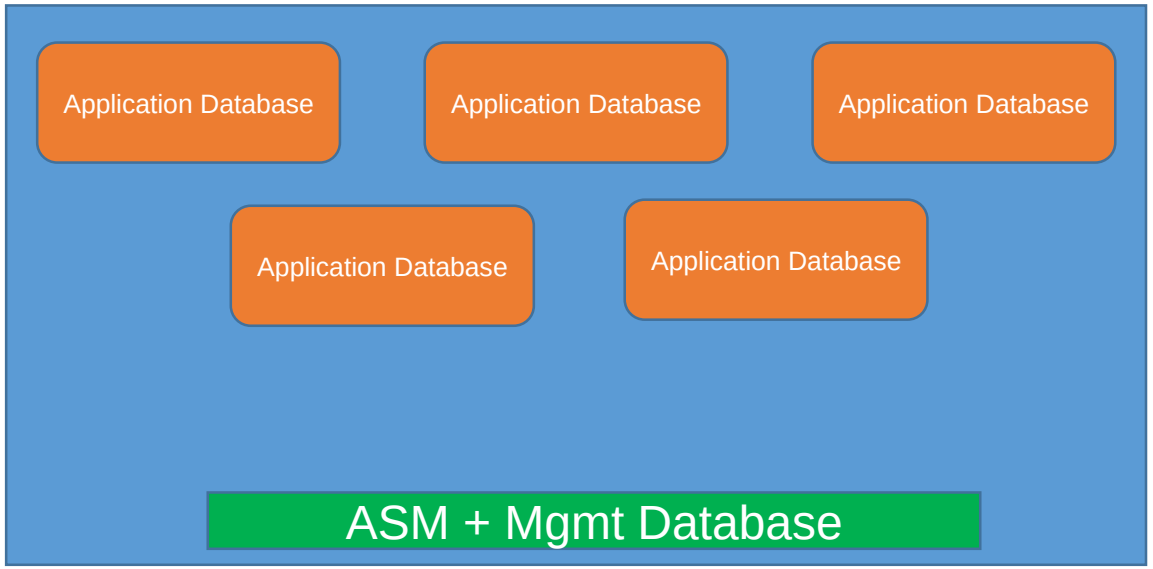
VMware



- 5 ASM Instances
- 5 Management Instances
- 5 Application Instances

- 5 Management Databases
- 5 Application Databases

Bare Metal



- 1 ASM Instance
- 1 Management Instance
- 5 Application Instances

- 1 Management Database
- 5 Application Databases

7 instances use less cpu than 15
7 instances use less memory than 15

Operating Systems

- AIX
  - Vendor lock-in to IBM P-Series servers and IBM support
  - Best traditional virtualization architecture: LPAR
  - Solid memory management
- Linux
  - No vendor lock-in
  - Solid memory management
- Solaris
  - Vendor lock-in to Oracle Sun Sparc servers and Oracle support (not a bad thing)
  - Extremely good virtualization architecture: LDOM, Containers
  - Solid memory management
- Windows
  - Seriously?

Operating Systems Environment

- The remaining slides in this section cover the details of properly configuring your environment and will not be covered in this presentation
- HugePages
- Name Resolution and DNS Caching
  - /etc/nscd.conf
  - /etc/resolv.conf
- TCP/IP network optimizations
- NUMA architecture
- swappiness
- /etc/hosts
- /etc/profile
- /etc/sysctl.conf
- /etc/security/limits
- STIGs

- Creating GROUPS and USERS
- bash environment
- installation directory structure
  - GRID_BASE
  - ORACLE_BASE
  - ORACLI_BASE

HugePages (1:3)

- For Oracle Databases, using HugePages reduces the operating system maintenance of page states, and increases the Translation Lookaside Buffer (TLB) hit ratio
- Enabling HugePages makes it possible for the operating system to support memory pages greater than the default (usually 4KB)
- Using very large page sizes can improve system performance by reducing the amount of system resources required to access page table entries Advantages of configuring HugePages
  - Page size is set to 2MB: substantially larger than 4K
  - Memory is locked and cannot be paged out
- When using HugePages the entire SGA must fit within the HugePage allocation

```
cat /proc/meminfo |grep HugePages
HugePages_Total:       0
HugePages_Free:        0
HugePages_Rsvd:        0
HugePages_Surp:        0
Hugepagesize:       2048 kB
```

HugePages (2:3)

- The first step in allocating HugePages to use the following formula to calculate the vm.nr_hugepages kernel parameter which is a value large enough to hold all SGAs

```
[Desired HugePage Allocation/2,048,000 = [Number of Pages to Allocate]
```

- So, for example on an ODA Oracle allocates 96GB to HugePages

```
16 * 1,024,000,000) = 98,304,000,000 bytes
98,304,000,000 / 2,048,000 = 48,000 pages
```

- To set 48,000 pages edit /etc/sysctl.conf so it includes the following line

```
vm.nr_hugepages=48000
```

  then reboot the operating system and verify configuration (see next slide)
- If using Oracle 11g AMM must be disabled (which you should do anyway)
- If SGA sizing is dynamic the number of HugePages must reflect that maximum size to which the SGA, or a total of all SGAs, can grow

Note: Oracle provides code for performing the calculation at: https://docs.oracle.com/cd/E37670_01/E37355/html/ol_config_hugepages.html

HugePages (3:3)

- The oracle userid needs to be reconfigured to enable it to lock a greater amount of memory which is done in /etc/security/limits.conf

```
oracle soft memlock 12582912
oracle hard memlock 12582912
```

- Verifying HugePage allocation on an ODA can return the following and you should see something similar on your system

```
cat /proc/meminfo |grep HugePages
HugePages_Total:    26000
HugePages_Free:     24183
HugePages_Rsvd:      6376
HugePages_Surp:         0
Hugepagesize:        2048 kB
```

Name Resolution and DNS Caching

- When DNS caching is enabled DNS look-up results are cached in the operating system so that future requests can leverage the cached information and do not have to hit DNS resources, with the attendant delay to resolve names
- On Linux (and probably most Unix), there is no OS-level DNS caching unless **`nscd`** is installed and running
- **`nscd`** is a daemon that provides a cache for the most common name service requests and watch for changes in configuration files appropriate including **`/etc/passwd`**, **`/etc/hosts`**, and **`/etc/resolv.conf`**
- There are two caches
  - a positive one for items found
  - a negative one for items not found
- Each cache has a separate TTL (time-to-live) period for its data
- The default configuration file, **`/etc/nscd.conf`**, determines cache daemon behavior

/etc/nscd.conf (1:2)

- Out of the box

```
$ grep hosts /etc/nscd.conf
        enable-cache hosts yes
        positive-time-to-live hosts 0
        negative-time-to-live hosts 0
        keep-hot-count hosts 20
        check-files hosts yes
```

```
$ nscd -g
CACHE: hosts

        CONFIG:
         enabled: yes
         per user cache: no
         avoid name service: no
         check file: yes
         check file interval: 0
         positive ttl: 0
         negative ttl: 0
         keep hot count: 20
         hint size: 2048
         max entries: 0 (unlimited)

        STATISTICS:
         positive hits: 0
         negative hits: 0
         positive misses: 0
         negative misses: 0
         total entries: 0
         queries queued: 0
         queries dropped: 0
         cache invalidations: 0
         cache hit rate:         0.0
```

/etc/nscd.conf (2:2)

- After cache configuration

```
$ grep hosts /etc/nscd.conf
        enable-cache hosts yes
        positive-time-to-live hosts 60
        negative-time-to-live hosts 60
        keep-hot-count hosts 20
        check-files hosts yes
```

```
$ nscd -g
CACHE: hosts

        CONFIG:
         enabled: yes
         per user cache: no
         avoid name service: no
         check file: yes
         check file interval: 0
         positive ttl: 60
         negative ttl: 0
         keep hot count: 20
         hint size: 2048
         max entries: 0 (unlimited)

        STATISTICS:
         positive hits: 143
         negative hits: 1
         positive misses: 20
         negative misses: 41
         total entries: 20
         queries queued: 0
         queries dropped: 0
         cache invalidations: 0
         cache hit rate:       70.2
```

- Enabling a 60 sec. cache reduced DNS lookup by 70%

/etc/resolv.conf

- An improperly configured resolv.conf file can result in everything from poor performance to an inability to connect making the database inaccessible
- The first resolv.conf example created a near outage condition at a SaaS Cloud provider

```
search morgan.priv
nameserver 10.24.244.200
nameserver 10.24.244.21 (Bind server 01)
nameserver 10.24.244.25 (Bind server 02)
nameserver 10.24.244.29 (Bind server 03)
```

- What belongs in every resolv.conf file

Parameter	Description
attempts	The number of times the resolver will send a query to its name servers before returning an error
rotate	Forces round-robin selection of name servers to spread the query load among all listed servers,
timeout	The number of seconds the resolver will wait for a response from a remote name server before retrying the query via a different name server

- Performance optimized

```
search morgan.priv
nameserver 10.24.244.21 (Bind server 01)
nameserver 10.24.244.25 (Bind server 02)
nameserver 10.24.244.29 (Bind server 03)
option attempts:2
option rotate
option timeout:1
```

Networks: TCP/IP

- The following do not appear to be critical in Linux 6 or above but in Linux 5 are clearly part of a discussion that should be had with your network and system admins

```
--enable TCP kernel auto-tuning
/proc/sys/net/ipv4/tcp_moderate_rcvbuf (1=on)

-- tune TCP max memory: tune to 2xBDP (Bandwidth x Delay Product)
-- For example, with 40 Mbits/sec bandwidth, 25 msec delay,
-- BDP = (40 x 1000 / 8 Kbytes/sec) x (0.025 sec) ~ 128 Kbytes
/proc/sys/net/ipv4/tcp_rmem 4096 87380 174760
/proc/sys/net/ipv4/tcp_wmem 4096 87380 174760

-- tune the socket buffer sizes by setting to 2xBDP
/proc/sys/net/core/rmem_max
/proc/sys/net/core/wmem_max

-- ensure that TCP Performance features are enabled (set to 1)
/proc/sys/net/ipv4/tcp_sack (to set sysctl -w net.ipv4.tcp_sack=1)
/proc/sys/net/ipv4/tcp_window_scaling
/proc/sys/net/ipv4/tcp_timestamps
```

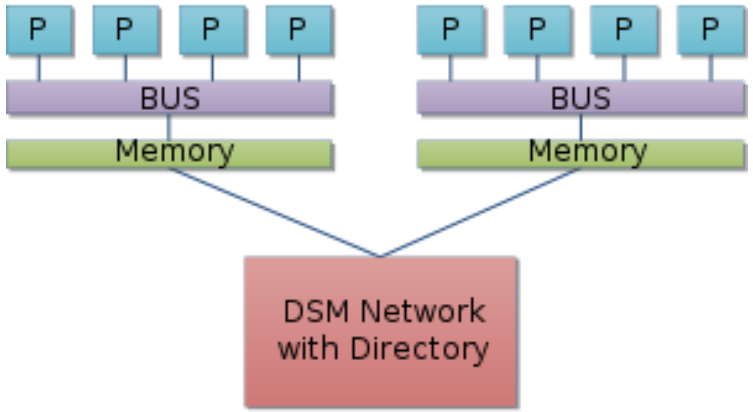
Networks: UDP

- Bandwidth-delay product is the product of network bandwidth and the round trip time of data going over the network
- To determine the round trip time, is to use a command such as ping from one host to another and use the response times returned by ping
- For example, if a network has a bandwidth of 100 Mbps and a round trip time of 5ms, then the send and receive buffers should be at least (100*10^6) * (5/10^3) bits or approximately 62.5 Kilobytes
- The following equation shows the relationships between the units and factors involved

```
100,000,000 bits   1 byte  5 seconds
---------------- x ------ x --------- = 62,500 bytes
 1 second           8 bits     1000
```

NUMA Memory Allocation

- Non-Uniform Memory Access
  - A memory design used in multiprocessing, where the memory access time depends on the memory location relative to the processor
  - A processor can access its own local memory faster than non-local memory
  - The benefits of NUMA are limited to particular workloads, notably on servers where the data are often associated strongly with certain tasks or users



  - Oracle recommends disabling NUMA at the hardware level: System Admins don't
  - If VM's are in use they too must be NUMA aware

Diagram Source: Wikipedia

NUMA Usage Detection

NUMA Not Configured on an ODA

```
[root@hc1pl-oda01 etc]# numactl --hardware
available: 1 nodes (0)
node 0 size: 262086 MB
node 0 free: 113558 MB
node distances:
node   0
  0:  10

[root@hc1pl-oda01 etc]# numactl --show
policy: default
preferred node: current
physcpubind: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41
42 43 44 45 46 47
cpubind: 0
nodebind: 0
membind: 0
```

NUMA Configured

```
[dmorgan@lxorap1n5 ~]$ numactl --hardware
available: 2 nodes (0-1)
node 0 size: 48457 MB
node 0 free: 269 MB
node 1 size: 48480 MB
node 1 free: 47 MB
node distances:
node   0   1
  0:  10  20
  1:  20  10

[dmorgan@lxorap1n5 ~]$ numactl --show
policy: default
preferred node: current
physcpubind: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
cpubind: 0 1
nodebind: 0 1
membind: 0 1
```

Swappiness

- Specifies a bias value for the kernel to swap out memory pages used by processes in the cgroup rather than reclaim pages from the page cache
- A value smaller than the default value of 60 reduces the kernel's preference for swapping out
- A value greater than 60 increases the preference for swapping out
- A value greater than 100 allows the system to swap out pages that fall within the address space of the cgroup's tasks

Value	Swapping Strategy
0	The kernel will swap only to avoid an out of memory condition
60	The default value
100	The kernel will swap aggressively

/etc/hosts

- 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
```

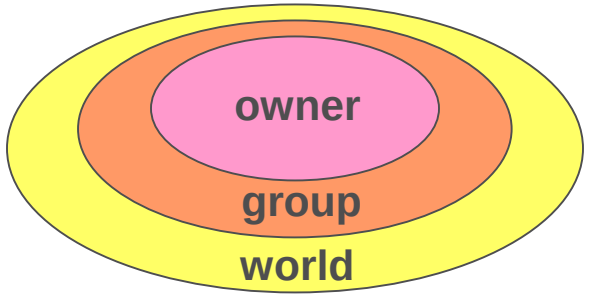
/etc/profile

- The shell program **`/bin/bash`** uses a collection of startup files to help create the environment
- Each file has a specific use and may affect login and interactive environments differently
- The files in the **`/etc`** directory generally provide global settings
- If an equivalent file exists in a home directory it may override the global settings
- An interactive login shell is started after a successful login, using **`/bin/login`**, by reading the **`/etc/passwd`** file
- This bash shell invocation normally reads **`/etc/profile`** and its private equivalent **`~/.bash_profile`** upon startup
- **`ulimit`** controls the maximum number of processes a user is authorized to have
- **`umask`** controls the permission on newly created files and is the inverse of **`chmod`** (133 = 644)

```
cat >> /etc/profile <<EOF
 if [ $USER = "oracle" ]; then
   ulimit -u 16384 -n 65536
   umask 133
 fi
 EOF
```

umask

- Clearly the greatest security comes from using the lowest possible permission value and for an optimized installation that means no more permissive than 644
- There is literally no excuse for anything in the oracle file system being executable by "world"



Value	Result
111	---x--x--x
222	--w--w--w-
333	--wx-wx-wx
444	-r--r--r--
555	-r-xr-xr-x
666	-rw-rw-rw-
777	-rwxrwxrwx
124	---x-w-r--
644	---wr--r--
755	-rwxr-xr-x

/etc/sysctl.conf (1:5)

- The overwhelming majority of Oracle Database's are not configured in accordance with documented recommendations
- Here are those recommendations for version 12.1 with common errors in red

Parameter	Value
semmsl	250
semmns	32000
semopm	100
semmni	128
shmall	50 percent of the size of physical memory in pages
shmmax	Half the size of physical memory in bytes. See My Oracle Support Note 567506.1 for additional information about configuring
shmmni	4096
panic-on-oops	1
file-max	(512 * processes) + open O/S file handles but not less than 6815744
aio-max-nr	fs.aio-max-nr = 1048576
ip_local_port_range	net.ipv4.ip_local_port_range = 9000 65500
rmem_default	262144
rmem_max	4194304
wmem_default	262144
wmem_max	1048576

/etc/sysctl.conf (2:5)

- FS.FILE-MAX
  - Far too often I see this configured as follows:

```
fs.file-max = 6815744
```

  - But here's what the docs actually say:
    - "Oracle recommends that for each Oracle database instance found within a system, allocate **512*PROCESSSES** in addition to the open file handles already assigned to the operating system"
    - "Oracle recommends a value no smaller than 6815744"
    - "PROCESSES within a database instance refers to the maximum number of processes that can be concurrently connected to the Oracle database by the oracle user"
      - The default value for processes is 300 but is not an indication that processes in your production rdbms will require no optimizations that could change this value
      - Thus if more than one database is installed on your server the number may need to be adjusted
      - If you have deployed 12c RAC, by definition, you have the ASM instance and _MGMTDB management database too so minimum processes going to be substantially higher than 300

/etc/sysctl.conf (3:5)

- FS.FILE-MAX
  - The configuration from my Windows laptop deployment of 12.1.0.2

```
--the output from my Windows laptop
 SQL> show parameter processes

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------
aq_tm_processes                      integer     1
db_writer_processes                  integer     1
gcs_server_processes                 integer     0
global_txn_processes                 integer     1
job_queue_processes                  integer     1000
log_archive_max_processes            integer     4
processes                            integer     300
```

/etc/sysctl.conf (4:5)

- So let's do the math for the following
  - Oracle Database with 800 processes
  - RAC management database with 300 processes
  - ASM instances with 600 processes
  - Linux with a reasonable number of Default Linux Processes: 173

```
(512 * (800+300+600) + 173 = 870573
```

- 870,573 is a small fraction of 6,814,744 so unless you are running a very large number of databases, or other applications, the default value should be acceptable
- But if you are consolidating multiple instances onto a single platform the default number may be inadequate ... do the math

/etc/sysctl.conf (5:5)

- SHMALL
  - By definition SHMALL specifies "... the total amount of shared memory, in pages, that the system can use at one time."
  - And should be set as follows " half the size of physical memory in pages"
  - On a system 96GB RAM and HugePages defined the correct value should be 24000
    - Substantially smaller than the number often used which is 2097152 for far less RAM
- SHMMAX
  - Essentially everyone puts in what Oracle calls the maximum possible value which is 4294967295 ignoring the documentation: Do the calculation and put in the correct value
  - Here is what Oracle advises in MOS Document "**Maximum SHMMAX values for Linux x86 and x86-64" (Doc ID 567506.1)**

In an Oracle RDBMS application, this "physical limit" still leaves inadequate system memory for other necessary functions. Therefore, the common "Oracle maximum" for SHMMAX that you will often see is "1/2 of physical RAM".

- PANIC-ON-OOPS
  - This is a new parameter with Database 12cR1 ... be sure it is set

```
kernel.panic_on_oops = 1
```

/etc/security/limits.conf (1:2)

- **`limits.conf`** is the configuration file for the pam_limits module
- The pam_limit module applies ulimits limits, nice priority, and number of simultaneous login session limits to user login sessions
- Entries with "hard" enforce hard resource limits which are limits set by the superuser and enforced by the Kernel
  - The user cannot raise his requirement of system resources above such values
- Entries with "soft" enforce soft resource limits which are limits that the user can move up or down within the range permitted by any pre-existing hard limits

/etc/security/limits.conf (2:2)

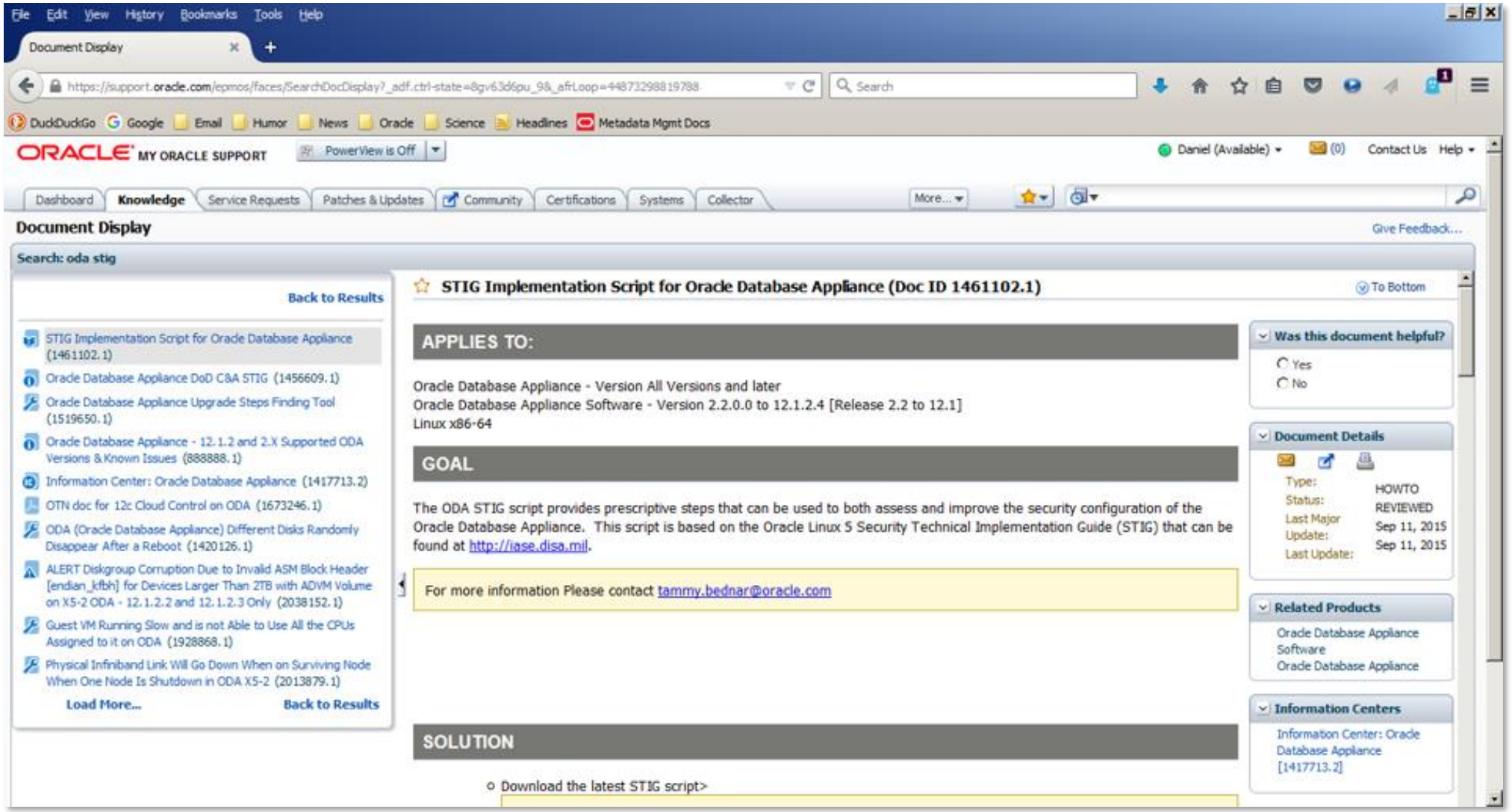
- The following limits parameters are new with Database 12c
  - ORACLE SOFT STACK
    At least 10240
  - ORACLE HARD STACK
    At least 10240 but not more than 32768KB
  - MEMLOCK SOFT
    At least 90% of the current memory RAM when HugePages memory is enabled but less than the amount of installed memory: Oracle demos use 92%
  - MEMLOCK HARD
    At least 90% of the current memory RAM when HugePages memory is enabled but less than the amount of installed memory: Oracle demos use 92%
  - Assuming 96GB RAM

```
oracle soft nofile 1024
oracle hard nofile 65536
oracle soft nproc 2047
oracle hard nproc 16384
oracle soft stack 10240
oracle hard stack 10240
oracle soft memlock 90439680
oracle hard memlock 90439680
```

STIG (1:7)

- A STIG is a **S**ecurity **T**echnical **I**mplementation **G**uide produced or approved by the US Department of Defense
- Oracle Support provides downloadable scripts that can be used to check an for STIG compliance and report three levels of violations
- We strongly recommend running the most appropriate STIG script with the **`-check`** option and recommend having your security and admin teams identify issues to be corrected and that modifications be made manually rather than running with the **`-fix`** option: The **`-fix`** option's "fix" may be more extreme than you expect

STIG (2:7)


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]

STIG (3:7)

Features

- Works on Oracle Database Appliance Bare Metal and Virtualized platform(Execution of the script from ODA_BASE only)
- Works on X5-2, X4-2, X3-2 & V1 platforms

Usage

- Download the script and execute it as root. Sample usage scenarios are documented below
- The script logs its actions in the "/opt/oracle/oak/log/<hostname>/stig/stig.log" file
- The option -check is used to check the system for any violation of the guidelines
- The option -force is used to re-run the script even if there are no violations
- The option -fix is used to implement the guidelines
- The enable and disable option can be used to enable or disable direct ssh logging as root. Direct ssh login as root is required for Patching and therefore before patching, the unlock needs to be executed.
- Once a violation has been fixed, it cannot be automatically rolled back to a previous state.

Sample usage

#./stig.py -h

Usage for STIG (Security Technical Implementation Guide):

STIG (4:7)

```
STIG checks and corrects violations within Oracle Database Appliance

<First Parameter>       : -h | -? | -help | -v | -V | -version | check | fix | enable | disable

<Second Parameter>      : all | force | perm | conf | account | access | grub | audit


Example                 : ./stig.py <First Parameter> <Second Parameter>

STIG script Parameter Information:

-------------------------------------------------------------------------------

-h                      : Provides information regarding STIG scripts

-v                      : Provides STIG script version information

enable                  : Enables direct ssh root login on the system

disable                 : Disables direct ssh root login on the system

check                   : Checks and lists the STIG violations on the system

check -h                : Provides options help available with check

fix                     : Fixes or Corrects the STIG violations reported on the system

fix -h                  : Provides options help  available with fix

-------------------------------------------------------------------------------------------------------
```

STIG (5:7)

- Typical Level 1 Violations
  - 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 (6:7)

- Typical Level 2 Violations
  - Access to cron is not through cron.allow and cron.deny
  - ekshell supported by the pam.rhost
  - Force of at least one lower case character is not set for password
  - FAIL_DELAY is not present in /etc/login.defs
  - Login delay is not enabled in /etc/pam.d/system-auth
  - Maximum age for a password change is more than 60 days
  - Non privileged account oprofile found on system
  - Non privileged account avahi-autoipd found on system
  - pam_tally not used to lock account after 3 consecutive failed logins
  - Password can be changed more than once in 24 hours
  - Remember not used in PAM configuration files
  - Permission of directory /root is more permissive than octal 700
  - Files in directory '/etc/xinetd.d/' have permission which are more permissive than octal 440
  - Unnecessary account games found on system

STIG (7:7)

- Typical Level 3 Violations
  - 9330 manual pages in directory '/usr/share/man/' have permission which are more permissive than octal 640
  - Permission of directory /home/grid/.mozilla/extensions is more permissive than octal 750
  - Permission of directory /home/grid/.mozilla/plugins is more permissive than octal 750
  - Permission of directory /home/oracle/.mozilla/extensions is more permissive than octal 750
  - Permission of directory /home/oracle/.mozilla/plugins is more permissive than octal 750
  - sendmail version is not hidden

Groups and Users (1:2)

- Essentially 100% of all database installations get this wrong
- Why?
- Because they follow the Oracle docs
- So let's get it right
- Here's what Oracle recommends

```
/usr/sbin/groupadd -g 490 oinstall (54321 default with validated OEL package)
/usr/sbin/groupadd -g 491 dba
/usr/sbin/groupadd -g 492 oper
/usr/sbin/groupadd -g 493 backupdba
/usr/sbin/groupadd -g 494 dgdba
/usr/sbin/groupadd -g 495 kmdba

/usr/sbin/useradd -u 500 -m -g oinstall -G dba,oper oracle
id oracle

-- set the password to oracle1
passwd oracle
```

Groups and Users (2:2)

- What's wrong with Oracle's recommendation?
- It enables a gross violation of basic security principles ... separation of duties
- If someone logs into the server as the user **`oracle`** they own everything under **`$ORACLE_BASE`**
- Create a separate group and user that will allow you to manage the database, and provide vendor access, without compromising the **`$ORACLE_BASE`** file system

```
/usr/sbin/groupadd -g 490 oinstall (54321 default with validated OEL package)
/usr/sbin/groupadd -g 491 dba
/usr/sbin/groupadd -g 492 oper
/usr/sbin/groupadd -g 493 backupdba
/usr/sbin/groupadd -g 494 dgdba
/usr/sbin/groupadd -g 495 kmdba
/usr/sbin/groupadd -g 496 cinstall

/usr/sbin/useradd -u 500 -m -g oinstall -G dba,oper oracle
id oracle
/usr/sbin/useradd -u 501 -m -g cinstall oracli
id oracli

-- set the passwords ... make them complex and different
passwd oracle
passwd oracli
```

oracle BASH Environment (1:2)

- Unless you have multiple databases defined within a single operating system environment define as much of the bash shell as you can in one of two files located at **`/home/oracle`**
  - .bash_profile
    - executed for login shells
    - executed once for all terminal windows
  - .bashrc
    - executed for interactive non-login shells
    - executed every time you open a new terminal window
- Avoid duplicating shell information you can call **`.bashrc`** from **`.bash_profile`** as demonstrated

```
-- add the following lines to .bash_profile

if [ -f ~/.bashrc ]; then
 source ~/.bashrc
fi

-- .bashrc is called when you login to your machine from a console
```

Directory Structure Creation

- Oracle Database Directories
  - If ASM and Oracle Clusterware will be installed create one additional file system owned by root for the installation
  - The $GRID_BASE directory structure can be built following Oracle's documented recommendations without compromising security

```
mkdir -p /app/oracle
chown -R oracle:dba /app/oracle
chmod -R 775 /app/oracle

mkdir /stageo
chown -R oracle:dba /stageo
```

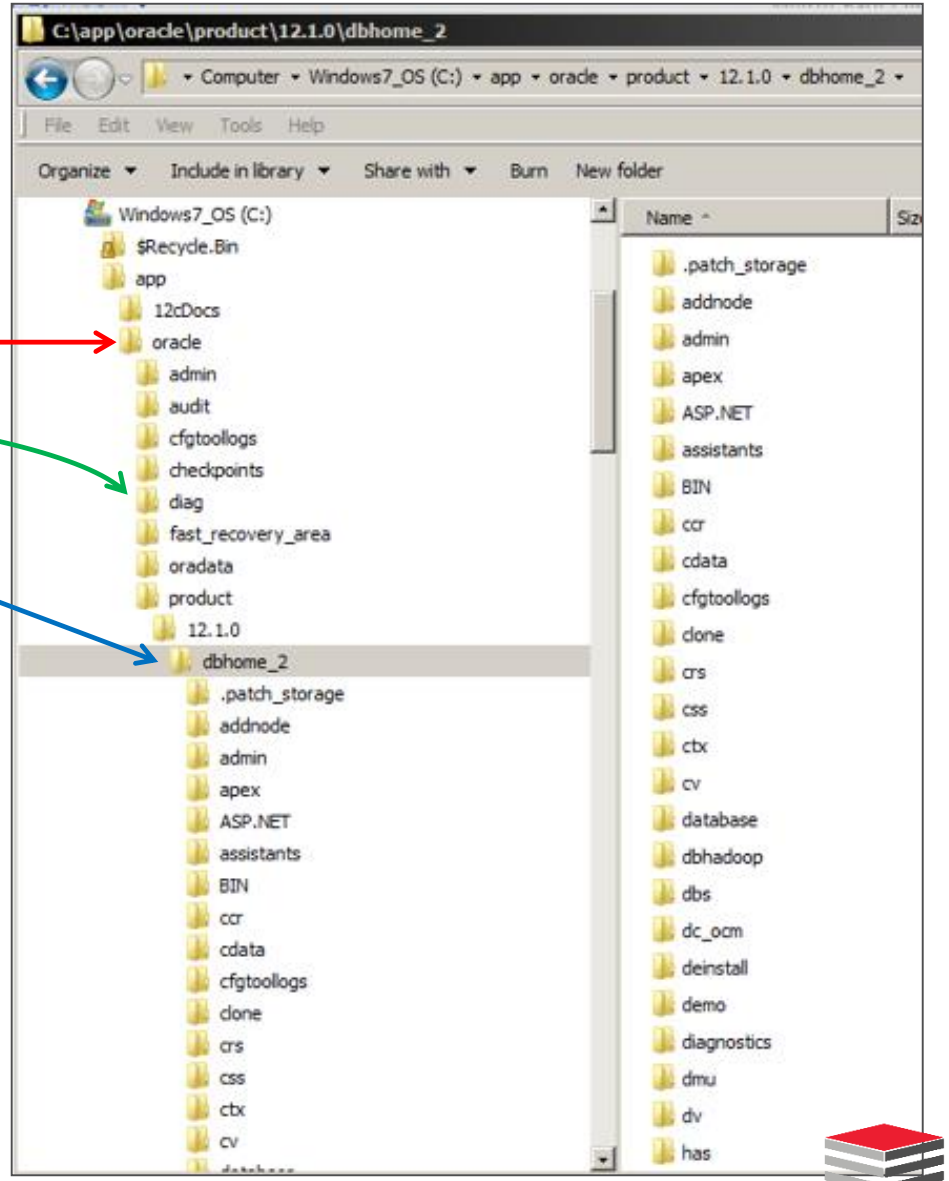
- Oracle Client Directories
  - Note that in addition to creating an entirely separate installation file system a separate staging directory is also created

```
mkdir -p /cli/oracle
chown -R oracli:cinstall /cli/oracle
chmod -R 775 /cli/oracle

mkdir /stagec
chown -R oracli:cinstall /stagec
```

oracle BASH Environment (2:2)

- The following is a typical .bashrc or .bash_profile file for an Oracle 12c Database

```
ORACLE_HOSTNAME=alpha1.mlib.org
ORACLE_BASE=/app/oracle/product
ADR_HOME=/app/oracle/diag
ORACLE_HOME=/app/oracle/product/12.1.0/db_1
ORACLE_SID=orabase
LD_LIBRARY_PATH=$ORACLE_HOME/lib:$LD_LIBRARY_PATH
TMP=/tmp
TEMP=/tmp
TMPDIR=/tmp
PATH=$ORACLE_HOME/bin:$PATH
export PATH ORACLE_BASE ORACLE_HOME ADR_HOME
export ORACLE_SID LD_LIBRARY_PATH
export TMP TEMP TMPDIR

alias oh='cd $ORACLE_HOME'
```



oracli BASH Environment

- The same rules apply to the owner of the Oracle Client software ... define the environment in either .bash_profile or .bashrc being careful to create no overlaps that would compromise file system security

```
ORACLE_HOSTNAME=alpha1.mlib.org
ORACLI_BASE=/cli/oracle/product
ORACLI_HOME=/cli/oracle/product/12.1.0/db_1
ORACLE_SID=orabase
LD_LIBRARY_PATH=$ORACLI_HOME/lib:$LD_LIBRARY_PATH
TMP=/tmp
TEMP=/tmp
TMPDIR=/tmp
PATH=$ORACLI_HOME/bin:$PATH
export PATH ORACLI_BASE ORACLI_HOME
export ORACLE_SID LD_LIBRARY_PATH
export TMP TEMP TMPDIR

alias oh='cd $ORACLI_HOME'
```

Database Installation

CREATE DATABASE (1:2)

- My very first CREATE DATABASE
- It was for EBS
- You won't see one like this ever again
- Be grateful

```
spool $HOME/CreateDB.log

CREATE DATABASE ctl1102A
maxdatafiles 1022
maxlogmembers 4
character set "WE8ISO8859P1"
DATAFILE '/u03/oradata/ctl1102A/system01.dbf' SIZE 1G
AUTOEXTEND ON
NEXT 25M
MAXSIZE 1G
LOGFILE
 GROUP 1 ('/u05/oradata/redo01a.log','/u06/oradata/redo01b.log') SIZE 500M,
 GROUP 2 ('/u05/oradata/redo02a.log','/u06/oradata/redo02b.log') SIZE 500M,
 GROUP 3 ('/u05/oradata/redo03a.log','/u06/oradata/redo03b.log') SIZE 500M;

CREATE TABLESPACE USERS
DATAFILE '/u03/oradata/ctl1102A/users01.dbf' SIZE 5M
AUTOEXTEND ON NEXT 5 MAXSIZE 2G;

CREATE TABLESPACE RBS
DATAFILE '/u07/oradata/ctl1102A/rbs01.dbf' SIZE 1G
AUTOEXTEND ON NEXT 5 MAXSIZE 2G;

CREATE TABLESPACE TOOLS
DATAFILE '/u03/oradata/ctl1102A/tools01.dbf' SIZE 50M
AUTOEXTEND ON NEXT 5 MAXSIZE 2G;

CREATE TABLESPACE CTXD
DATAFILE '/u13/oradata/ctl1102A/ctxd01.dbf' SIZE 50M
AUTOEXTEND ON NEXT 5 MAXSIZE 2G;

CREATE TABLESPACE TEMP
DATAFILE '/u04/oradata/ctl1102A/temp01.dbf' SIZE 100M
AUTOEXTEND ON NEXT 5 MAXSIZE 2G;

CREATE TABLESPACE AKD
DATAFILE '/u13/oradata/ctl1102A/akd01.dbf' SIZE 1M
AUTOEXTEND ON NEXT 1 MAXSIZE 2G;
```

CREATE DATABASE (2:2)

```
CREATE DATABASE <database_name>
USER SYS IDENTIFIED BY <password>
USER SYSTEM IDENTIFIED BY <password>
CONTROLFILE REUSE
MAXDATAFILES <integer>
MAXINSTANCES <integer>
CHARACTER SET <character_set_name>
NATIONAL CHARACTER SET <character_set_name>
SET DEFAULT <BIGFILE | SMALLFILE> TABLESPACE
LOGFILE
       [GROUP <integer> <file_specification>,]
       [GROUP <integer> <file_specification>,]
       [GROUP <integer> <file_specification>]
MAXLOGFILES <integer>
MAXLOGMEMBERS <integer>
MAXLOGHISTORY <integer>
<ARCHIVELOG | NOARCHIVELOG>
[FORCE] LOGGING
EXTENT MANAGEMENT LOCAL
DATAFILE <system_file_specification>
SYSAUX DATAFILE <file_specification>
DEFAULT TABLESPACE <tablespace_name>
EXTENT MANAGEMENT LOCAL
UNIFORM SIZE <integer><M | G | T | P | E>
<BIGFILE | SMALLFILE>DEFAULT TEMPORARY TABLESPACE <tablespace_name>
TEMPFILE <file_specification> [SIZE <integer><M | G | T | P | E>]
AUTOEXTEND <OFF | ON> NEXT [SIZE <integer><M | G | T | P | E>]>] MAXSIZE [SIZE
<integer><M | G | T | P | E>]>]
[<AUTOALLOCATE | UNIFORM [SIZE <integer><M | G | T | P | E>]>]
<BIGFILE | SMALLFILE> UNDO TABLESPACE <tablespace_name>
DATAFILE <file_specification> [SIZE <integer><M | G | T | P | E>]
AUTOEXTEND <OFF | ON> NEXT [SIZE <integer><M | G | T | P | E>]>] MAXSIZE [SIZE
<integer><M | G | T | P | E>]>]
EXTENT MANAGEMENT LOCAL AUTOALLOCATE
SET TIME_ZONE = <time_zone_region>
ENABLE PLUGGABLE DATABASE SEED <seed_tablespace_clause>;
```

OUI + NETCA + DBCA

- OUI: Install Oracle Binaries
- NETCA: Install Listener
- DBCA: Install Database
- Preferably use the tools to build response files and then execute the files from SQL*Plus
- FRA
  - Determine what is going to be written to the FRA
    - Redo log multiplexing
    - Archived redo logs
    - Backups
  - Does it need to have its own file system or is it an ASM Disk Group?
- Control File multiplexing
  - By default OUI+DBCA puts all control file copies into the same location

Redo Logs (1:4)

- The Oracle installer has not been informed of another critically important configuration issue: Redo logs need to be multiplexed and appropriately sized
- By default the installer creates three redo groups each with only one member
  - Lose the CURRENT redo log and your database is toast
  - Lose the ACTIVE redo log and your database is possibly toast
  - In both cases expect an unrecoverable loss of data
  - Lose the INACTIVE redo log and your database will halt
- Does any of the above sound like "best practice"?
- Does any of the above sound like "unbreakable"?
- Does any of the above sound like an outage lurking in the data center?
- Be sure you multiplex redo logs to separate physical locations preferably written by different controllers

Redo Logs (2:4)

- Multiplex redo logs to separate physical disk

```
SQL> SELECT member FROM v_$logfile;

MEMBER
------------------------------------------------
/app/oracle/fast_recovery_area_orabase/redo01A.log
/app/oracle/fast_recovery_area_orabase/redo02A.log
/app/oracle/fast_recovery_area_orabase/redo03A.log

6 rows selected.

SQL> ALTER DATABASE ADD LOGFILE MEMBER '/app/oracle/dbs/log1b.log' TO GROUP 1;

SQL> ALTER DATABASE ADD LOGFILE MEMBER '/app/oracle/dbs/log2b.log' TO GROUP 2;

SQL> ALTER DATABASE ADD LOGFILE MEMBER '/app/oracle/dbs/log3b.log' TO GROUP 3;

SQL> SELECT member FROM v_$logfile;

MEMBER
------------------------------------------------
/app/oracle/fast_recovery_area_orabase/redo01A.log
/app/oracle/fast_recovery_area_orabase/redo02A.log
/app/oracle/fast_recovery_area_orabase/redo03A.log
/app/oracle/oradata/orabase/redo01B.log
/app/oracle/oradata/orabase/redo02B.log
/app/oracle/oradata/orabase/redo03B.log
```

Redo Logs (3:4)

- Monitor redo log switch frequency to identify high-risk activities

```
SELECT TO_CHAR(first_time,'MMDD') MMDD,
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'00',1,0)),'99') "00",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'01',1,0)),'99') "01",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'02',1,0)),'99') "02",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'03',1,0)),'99') "03",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'04',1,0)),'99') "04",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'05',1,0)),'99') "05",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'06',1,0)),'99') "06",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'07',1,0)),'99') "07",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'08',1,0)),'99') "08",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'09',1,0)),'99') "09",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'10',1,0)),'99') "10",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'11',1,0)),'99') "11",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'12',1,0)),'99') "12",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'13',1,0)),'99') "13",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'14',1,0)),'99') "14",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'15',1,0)),'99') "15",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'16',1,0)),'99') "16",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'17',1,0)),'99') "17",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'18',1,0)),'99') "18",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'19',1,0)),'99') "19",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'20',1,0)),'99') "20",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'21',1,0)),'99') "21",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'22',1,0)),'99') "22",
TO_CHAR(SUM(DECODE(TO_CHAR(first_time,'HH24'),'23',1,0)),'99') "23"
FROM v$log_history
GROUP BY TO_CHAR(first_time,'MMDD') ORDER BY 1;
```

Redo Logs (4:4)

- Monitor redo log switch frequency to identify high-risk activities

MMDD	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
0609	16	11	9	8	8	10	12	8	8	10	8	10	14	10	11	15	15	8	12	8	7	6	9	7
0610	13	12	8	9	7	6	11	9	6	8	7	8	12	6	7	6	8	7	10	7	4	4	4	5
0611	12	8	5	9	9	7	11	7	6	7	8	5	12	9	10	8	9	12	12	10	6	6	9	8
0612	13	12	7	9	7	9	10	10	7	7	9	8	11	7	7	8	7	7	11	9	5	6	8	7
0613	12	11	7	8	8	7	13	7	9	7	8	7	13	10	9	8	8	8	11	8	7	5	7	6
0614	15	10	9	9	8	9	13	9	9	7	11	13	11	9	8	9	13	9	12	9	7	9	7	7
0615	15	10	10	8	10	9	12	8	9	8	9	7	13	6	8	7	7	7	15	10	7	7	7	5
0616	13	8	8	7	7	6	10	8	11	7	8	6	11	7	12	13	13	14	13	9	9	9	7	8
0617	15	13	10	9	8	9	16	8	8	10	9	10	16	11	10	10	8	11	13	8	9	9	7	9
0618	12	13	15	15	13	13	15	13	9	12	8	11	14	9	10	9	9	8	14	9	8	8	9	8
0619	16	11	10	11	9	9	13	12	10	9	12	12	17	8	9	9	11	11	14	9	9	11	10	12
0620	19	15	11	10	10	10	19	11	9	9	9	9	13	7	15	10	11	11	12	10	9	11	11	10
0621	13	16	11	9	10	13	16	8	14	9	11	12	17	10	10	11	8	11	14	8	11	14	8	11
0622	16	13	13	11	11	9	16	9	9	11	10	11	17	10	9	10	10	10	13	14	9	10	10	8
0623	19	13	12	13	13	11	16	12	11	11	11	11	16	9	10	13	2	14	14	8	9	8	8	8
0624	14	9	9	9	7	9	11	8	8	7	8	8	14	7	8	7	9	3	6	0	0	0	0	0

...

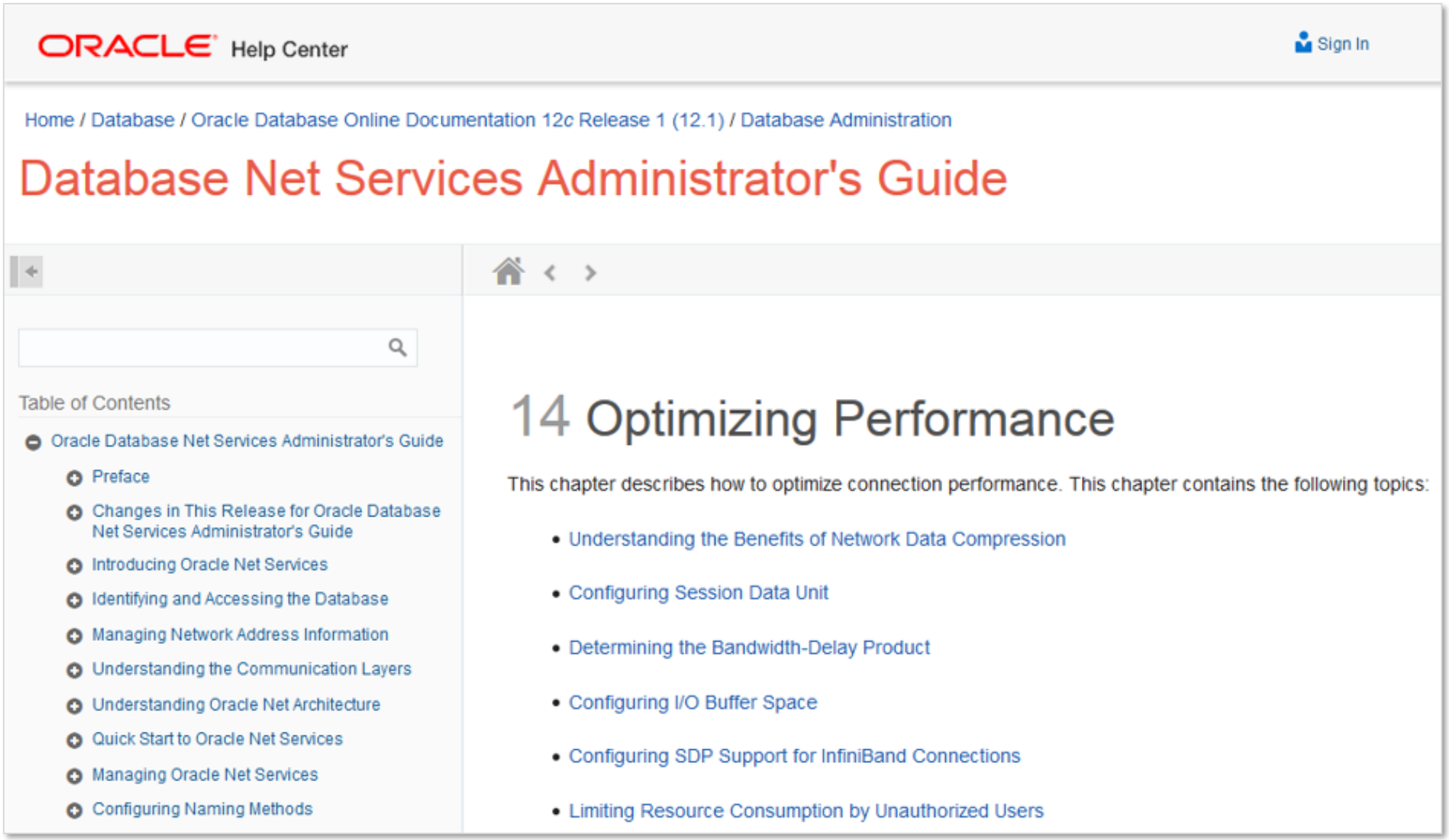
0630	7	4	23	19	9	10	5	6	7	17	19	17	15	17	15	43	40	32	17	15	14	20	13	15
0701	15	12	14	12	13	12	13	17	15	17	20	20	18	18	17	15	14	13	10	10	15	15	13	19
0702	21	22	20	18	14	14	12	13	11	11	14	14	14	10	9	10	9	10	11	9	11	9	10	12
0703	9	13	10	17	14	17	15	17	23	20	19	20	17	19	16	17	15	17	15	15	15	16	16	18
0704	22	19	19	18	16	15	13	13	14	11	13	10	12	14	10	12	14	11	9	11	12	13	12	9
0705	14	13	9	11	10	12	13	11	11	8	10	10	11	11	11	12	10	10	9	10	8	9	12	7
0706	14	15	11	12	9	15	13	12	12	9	12	14	12	12	12	12	13	11	8	9	12	13	2	0
0707	0	0	1	0	3	15	10	10	7	8	10	11	12	8	6	9	13	12	9	8	9	8	10	10
0708	16	9	8	15	10	11	9	8	8	14	9	10	10	8	8	14	15	10	9	9	8	9	10	10
0709	13	12	9	10	10	9	9	10	11	11	8	9	9	8	9	13	8	9	6	9	9	11	10	9
0710	12	10	9	10	9	12	9	8	8	11	7	10	11	9	9	13	10	9	8	9	11	12	10	10

Listener Configuration

Oracle Listeners

- The first question with respect to listeners you must address is the number of listeners: Here are some of the important considerations
- Stand-alone database requires one local listener per O/S environment
- RAC databases require one Grid listener per O/S environment
- Data Guard best practices dictate two listeners per O/S environment
  - Public Listener: Often configured using port 1521 routed to a public switch for applications
  - Private Listener: Often using port 1526 routed to a private switch for replication
- Additional listeners may be best practice depending upon a number of factors including
  - Database version and patch level
  - Granular traffic control
  - Network pathing
  - ORACLE_HOMEs configuration supporting versions
  - Security isolation

Resource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Database Net Services Administrator's Guide
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14 Optimizing Performance
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Understanding the Benefits of Network Data Compression
Configuring Session Data Unit
Determining the Bandwidth-Delay Product
Configuring I/O Buffer Space
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Session Data Unit (SDU)

- The amount of data provided to Oracle Net to send at any one time is referred to as the message size
- Oracle Net assumes by default that the message size will normally vary between 0 and 8192 bytes, and infrequently, be larger than 8192 bytes
- If this assumption is true, then most of the time, the data is sent using one SDU buffer

SQLNET.ORA

- What goes into SQLNET.ORA affects all listeners and all tnsnames aliases
- If you have multiple listeners, "best practice" for Data Guard, perform listener specific configuration in the listener.ora file or parameters listed in sqlnet.ora will apply to both

```
NAMES.DIRECTORY_PATH=(TNSNAMES, EZCONNECT)

DEFAULT_SDU_SIZE=32767

ENCRYPTION_WALLET_LOCATION = (
  SOURCE=(METHOD=FILE) (METHOD_DATA=(DIRECTORY=/app/oracle/admin/orabase/wallet)))

SQLNET.ALLOWED_LOGON_VERSION=12a

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)
```

LISTENER.ORA (1:3)

- Stand-Alone

```
SID_LIST_LISTENER =
  (SID_LIST =
    (SID_DESC =
      (SID_NAME = CLRExtProc)
      (ORACLE_HOME = c:\app\oracle\product\12.1.0\dbhome_1)
      (PROGRAM = extproc)
      (ENVS = "EXTPROC_DLLS=ONLY:c:\app\oracle\product\12.1.0\dbhome_1\bin\oraclr12.dll")
    )
    (SID_DESC =
      (SID_NAME = PDBDEV)
      (ORACLE_HOME = c:\app\oracle\product\12.1.0\dbhome_1)
    )
    (SID_DESC =
      (SID_NAME = PDBTEST)
      (ORACLE_HOME = c:\app\oracle\product\12.1.0\dbhome_1)
    )
    (SID_DESC =
      (SID_NAME = PDBPROD)
      (ORACLE_HOME = c:\app\oracle\product\12.1.0\dbhome_1)
    )
  )

LISTENER =
  (DESCRIPTION_LIST =
    (DESCRIPTION =
      (ADDRESS = (PROTOCOL = TCP)(HOST = PERRITO4)(PORT = 1521))
      (ADDRESS = (PROTOCOL = IPC)(KEY = EXTPROC1521))
    )
  )

ADR_BASE_LISTENER = C:\app\oracle
```

LISTENER.ORA (2:3)

- RAC Grid Listener

```
LISTENER=(DESCRIPTION=(ADDRESS_LIST=(ADDRESS=(PROTOCOL=IPC)(KEY=LISTENER))))
 LISTENER_SCAN1=(DESCRIPTION=(ADDRESS_LIST=(ADDRESS=(PROTOCOL=IPC)(KEY=LISTENER_SCAN1))))
 ENABLE_GLOBAL_DYNAMIC_ENDPOINT_LISTENER_SCAN1=ON
 ENABLE_GLOBAL_DYNAMIC_ENDPOINT_LISTENER=ON
```

LISTENER.ORA (3:3)

- Data Guard

```
# /sbin/ifconfig
# listener.ora Network Configuration File: /app/oracle/product/11.2.0/dbhome_1/network/admin/listener.ora
# Generated by Oracle configuration tools.

DG_LISTENER =
  (DESCRIPTION_LIST =
    (DESCRIPTION =
      (ADDRESS = (PROTOCOL = TCP)(HOST = 10.0.4.1)(PORT = 1526))
      (SEND_BUF_SIZE=9375000)
      (RECV_BUF_SIZE=9375000))
    )
  )

SID_LIST_DG_LISTENER =
  (SID_LIST =
    (SID_DESC =
      (SDU = 32767)
      (GLOBAL_DBNAME = proda)
      (ORACLE_HOME = /app/oracle/product/11.2.0/dbhome_1)
      (SID_NAME = proda)
    )
  )

LISTENER =
  (DESCRIPTION_LIST =
    (DESCRIPTION =
      (ADDRESS = (PROTOCOL = TCP)(HOST = omega1.mlib.org)(PORT = 1521))
    )
  )

SID_LIST_LISTENER =
  (SID_LIST =
    (SID_DESC =
      (SID_NAME = PLSExtProc)
      (ORACLE_HOME = /app/oracle/product/11.2.0/dbhome_1)
      (PROGRAM = extproc)
   )
  )
```

TNSNAMES.ORA

- With 12c you must manually add an entry for CDB$ROOT and for every PDB

```
# tnsnames.ora Network Configuration File: C:\app\oracle\product\12.1.0\dbhome_1\network\admin\tnsnames.ora
# Generated by Oracle configuration tools.

ORACLR_CONNECTION_DATA =
  (DESCRIPTION =
    (ADDRESS_LIST =
      (ADDRESS = (PROTOCOL = IPC)(KEY = EXTPROC1521)))
    (CONNECT_DATA = (SID = CLRExtProc) (PRESENTATION = RO)))

ORABASE =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = 127.0.0.1)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = orabase)))

PDBDEV =
  (DESCRIPTION =
    (ADDRESS_LIST = (ADDRESS = (PROTOCOL = TCP)(HOST = 127.0.0.1)(PORT = 1521)))
    (CONNECT_DATA = (SERVICE_NAME = pdbdev)))

PDBTEST =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = 127.0.0.1)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = pdbtest)))


PDBPROD =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = 127.0.0.1)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = pdbprod)))
```

SPFILE

- As with other aspects of the Oracle Database default installation you will find that a number of initialization parameters are configured for backward compatibility ... not for maximizing stability, scalability, and security

```
ALTER SYSTEM SET global_names = TRUE CONTAINER = CURRENT SCOPE = BOTH;
ALTER SYSTEM SET remote_login_passwordfile = NONE  CONTAINER = ALL SCOPE = SPFILE;
ALTER SYSTEM SET sec_max_failed_login_attempts = 3 CONTAINER = ALL SCOPE = SPFILE;
ALTER SYSTEM SET sec_protocol_error_further_action = 1 CONTAINER = ALL SCOPE = SPFILE;
ALTER SYSTEM SET sec_protocol_error_trace_action = log CONTAINER = CURRENT SCOPE = BOTH;
ALTER SYSTEM SET use_large_pages = TRUE CONTAINER = ALL SCOPE = SPFILE;

-- shutdown the database and restart it so that these parameter changes take effect
```

Database Configuration: General

GLOGIN.SQL (1:2)

- Modify glogin.sql will not directly affect stability, scalability, or security but will greatly enhance your sanity and reduce the amount of time you spend doing the same job over-and-over-and-over again
- Find the file **`{ORACLE_HOME}/sqlplus/admin/glogin.sql`** and rename it to **`glogin.bak`**. Create a new file in the same directory named glogin.sql with the as follows contents
- You will likely want to add additional column (col) arguments as you work with the new database and find all of the places where Oracle's column widths have expanded, in many cases, to 128 bytes

```
set arraysize 250
set define off
set linesize 121
set long 1000000
set pagesize 45
set serveroutput on
set trim on
set trimspool on

col column_name format a30
col constraint_name format a30
col container_name format a30
col grantee format a30
col index_name format a30
col object_name format a30
```

```
col column_name format a30
col constraint_name format a30
col container_name format a30
col grantee format a30
col index_name format a30
col object_name format a30
col package_name format a30
col partition_name format a30
col pdb format a20
col synonym_name format a30
col table_name format a30
col type_name format a30
col type_owner format a30
col username format a30
col value format a30
```

GLOGIN.SQL (2:2)

- In addition it is recommended that you add the following two lines at the end of your glogin.sql file
- The first makes vi the default editor within SQL*Plus
- The second changes the default date column display format so that you can see time
- The third change guarantees that when you compile, or recompile, PL/SQL objects in SQL*Plus you will be able to see any generated compiler warnings

```
define _editor = vi
ALTER SESSION SET NLS_DATE_FORMAT='DD-MON-YYYY HH24:MI:SS';
ALTER SESSION SET PLSQL_WARNINGS='ENABLE:ALL';
```

Database Configuration: Scalability

SPFILE

- The spfile is configured, primarily, with ALTER SYSTEM statements
- The syntax should be always recognize the instance and container
- And always contain a comment

In 12c you can specify specific containers or all containers

MEMORY, SPFILE, or BOTH

In RAC you can specify a specific instance or all

```
ALTER SYSTEM SET "_enable_NUMA_support" = TRUE
COMMENT= 'NUMA Support Enabled 15-Mar-2015'
CONTAINER=ALL
SCOPE=SPFILE
SID='*';
```

Database Configuration: Security

Profiles (1:3)

- Oracle default installations include Profile configurations which are a combination of 16 resource names assigned to two different resource types

RESOURCE NAME	RESOURCE TYPE
KERNEL	COMPOSITE_LIMIT
KERNEL	CONNECT_TIME
KERNEL	CPU_PER_CALL
KERNEL	CPU_PER_SESSION
KERNEL	IDLE_TIME
KERNEL	LOGICAL_READS_PER_CALL
KERNEL	LOGICAL_READS_PER_SESSION
KERNEL	PRIVATE_SGA
KERNEL	SESSIONS_PER_USER

RESOURCE NAME	RESOURCE TYPE
PASSWORD	FAILED_LOGIN_ATTEMPTS
PASSWORD	PASSWORD_GRACE_TIME
PASSWORD	PASSWORD_LIFE_TIME
PASSWORD	PASSWORD_LOCK_TIME
PASSWORD	PASSWORD_REUSE_MAX
PASSWORD	PASSWORD_REUSE_TIME
PASSWORD	PASSWORD_VERIFY_FUNCTION

- At installation in 12c a single profile named DEFAULT is created
- Two actions are recommended at installation
  1. The default profile should be modified as described on the following slide
  2. A second profile should be created specifically for assignment to mech_ids (described later in this presentation)

Profiles (2:3)

- The DEFAULT profile provided by Oracle is the appearance of security without the substance
- The create substance perform the following steps
  - Open the file **$ORACLE_HOME/rdbms/admin/utlpwdmg.sql**
  - Scroll to the bottom of the file and extract the following SQL

```
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;
```

  - Modify it so that it looks like the following and run it as SYSDBA (in the root Container)

```
ALTER PROFILE DEFAULT LIMIT
PASSWORD_LIFE_TIME 60
PASSWORD_REUSE_TIME 365
PASSWORD_REUSE_MAX 1
FAILED_LOGIN_ATTEMPTS 3
PASSWORD_VERIFY_FUNCTION ora12c_strong_verify_function;
```

Profiles (3:3)

- The following profile is a good starting point for a mech_id profile

```
CREATE PROFILE c##mech_profile LIMIT
FAILED_LOGIN_ATTEMPTS 1
PASSWORD_LOCK_TIME 365
PASSWORD_GRACE_TIME 1
PASSWORD_LIFE_TIME 180
PASSWORD_REUSE_MAX 1
PASSWORD_REUSE_TIME 9999
IDLE_TIME 1440;
```

- If developers or auditors are allowed to connect to a production database they should not be allowed to use the default profile but rather have a profile written specifically for them with a much shorter PASSWORD_LIFE_TIME, IDLE_TIME, and a limit of no more than 2 SESSIONS_PER_USER

Password Verification

- The password verify function in database version 12c is substantially altered from previous versions
- Read `$ORACLE_HOME/rdbms/admin/utlpwdmg.sql` to document the changes
  - Review the CIS (Computer Internet Security) and DOD STIG profile modifications commented out
  - Read too catpvf.sql

Security 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_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

Secure Configuration

- In Database 12.c Oracle has added a new file **$ORACLE_HOME/rdbms/admin/secconf.sql** that you must read and learn
- SECCONF stands for Secure Configuration
- Here's the file's header

```
Rem    NAME
Rem      secconf.sql - SECure CONFiguration script
Rem
Rem    DESCRIPTION
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
Rem      included.
Rem
Rem
Rem    NOTES
Rem      Only invoked for newly created databases, not for upgraded databases
```

- This file affects the default profile and prompts for audit configuration
- If you don't enable **ORA_SECURECONFIG** expect your auditors to ask why

Privilege Revocation (1:2)

- There are a lot of objects for which Oracle's default installation grants access to PUBLIC and for which PUBLIC access is unnecessary and inappropriate for most deployments

Would you grant PUBLIC access to ALL_SOURCE?

```
REVOKE execute ON dbms_job FROM PUBLIC;
REVOKE execute ON dbms_obfuscation_toolkit FROM PUBLIC;
REVOKE execute ON dbms_random FROM PUBLIC;
REVOKE select ON all_source FROM PUBLIC;
REVOKE select ON role_role_privs FROM PUBLIC;
REVOKE select ON user_role_privs FROM PUBLIC;
REVOKE select ON user_sys_privs FROM PUBLIC;
REVOKE select ON user_tab_privs FROM PUBLIC;
```

- And if your database contains the user `scott` consider this

```
SQL> SELECT * FROM user_sys_privs;

USERNAME                       PRIVILEGE                ADM COM
------------------------------ ------------------------ --- ---
SCOTT                          UNLIMITED TABLESPACE     NO  NO
SCOTT                          CREATE CLUSTER           NO  NO
SCOTT                          CREATE TABLE             NO  NO
```

- Does `scott` really need unlimited tablespace?

Privilege Revocation (2:2)

```
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_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_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_scheduler_remote_databases 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;
```

Network Communications (1:3)

- The Oracle database contains built-in components that can be utilized to enable communications to the intranet and internet
- They can also be used to hack both internal and external networks
  - DBMS_NETWORK_ACL_ADMIN
  - DBMS_NETWORK_ACL_UTILITY
  - UTL_HTTP
  - UTL_INADDR
  - UTL_MAIL
  - UTL_SMTP
  - UTL_TCP
- Unfortunately many of them are, by default, exposed to PUBLIC

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

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

Network Communications (2:3)

- UTL_INADDR Demo

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

UTL_INADDR.GET_HOST_ADDRESS('WWW.ORACLE.COM')
--------------------------------------------
2600:1404:a:394::2d3e

SQL> SELECT utl_inaddr.get_host_address('umn.edu') FROM dual;

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

SQL> SELECT utl_inaddr.get_host_name('134.84.119.7') FROM dual;

UTL_INADDR.GET_HOST_NAME('134.84.119.7')
--------------------------------------------
isrv-w.tc.umn.edu

SQL> SELECT utl_inaddr.get_host_name('134.84.119.22') FROM dual;

UTL_INADDR.GET_HOST_NAME('134.84.119.22')
--------------------------------------------
isrv-w.tc.umn.edu

SQL> SELECT utl_inaddr.get_host_name('134.84.119.31') FROM dual;

UTL_INADDR.GET_HOST_NAME('134.84.119.31')
--------------------------------------------
isrv-w.tc.umn.edu
```

Network Communications (3:3)

- DBMS_NETWORK_ACL_ADMIN/UTILITY

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

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
```

Optimizer Settings

- ALL_ROWS and FIRST_ROWS define the default behavior of the instance's optimization approach
- Syntax

```
Range of values: {first_rows_[1 | 10 | 100 | 1000] | first_rows | all_rows}
```

- Altering the default value

```
ALTER SYSTEM SET optimizer_mode = FIRST_ROWS_10 SCOPE = BOTH SID='*';
```

System Event Triggers (1:2)

- DDL Event Triggers can prevent bad things from happening

```
CREATE OR REPLACE TRIGGER save_our_db
BEFORE DROP OR TRUNCATE
ON SCHEMA
DECLARE
 oper ddl_log.operation%TYPE;
BEGIN
  oper := ora_sysevent;
  log_proc(ora_sysevent, ora_dict_obj_owner, ora_dict_obj_name);

  IF oper = 'DROP' THEN
    RAISE_APPLICATION_ERROR(-20998, 'Attempt To Drop In Production Has Been Logged');
  ELSIF oper = 'TRUNCATE' THEN
    RAISE_APPLICATION_ERROR(-20999, 'Attempt To Truncate A Production Table Has Been Logged');
  END IF;
END save_our_db;
/
```

System Event Triggers (2:2)

- System Event Triggers can detect bad things you cannot detect any other way

```
CREATE OR REPLACE TRIGGER logon_failures
AFTER SERVERERROR
ON DATABASE
BEGIN
  IF (IS_SERVERERROR(1017)) THEN
    INSERT INTO connection_audit
    (login_date, user_name)
    VALUES
    (SYSDATE, 'ORA-1017');
    COMMIT;
  END IF;
END logon_failures;
/
```

User Authentication and Permissions

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

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

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

Oracle Default Roles

- There is literally no excuse for anyone having the CONNECT or RESOURCE roles
- Similarly no human should have the DBA role either
- Create your own DBA role with only the privileges actually required to manage the database

```
SQL> SELECT con_id, grantee, granted_role
  2  FROM cdb_role_privs
  3  WHERE granted_role IN ('CONNECT', 'RESOURCE')
  4  AND grantee NOT LIKE '%SYS%'
  5  AND grantee NOT LIKE '%GSM%'
  6  AND grantee NOT LIKE '%SPATIAL%'
  7  AND grantee NOT LIKE 'DV%'
  8  AND grantee NOT IN ('MDDATA', 'XDB')
  9* ORDER BY 2,3,1;

    CON_ID GRANTEE                        GRANTED_ROLE
---------- ------------------------------ ------------
         1 APEX_040200                    CONNECT
         3 APEX_040200                    CONNECT
         1 APEX_040200                    RESOURCE
         3 APEX_040200                    RESOURCE
         3 BI                             RESOURCE
         3 HR                             RESOURCE
         3 IX                             CONNECT
         3 IX                             RESOURCE
         1 LOGSTDBY_ADMINISTRATOR         RESOURCE
         3 LOGSTDBY_ADMINISTRATOR         RESOURCE
         3 OE                             RESOURCE
         1 OUTLN                          RESOURCE
         3 OUTLN                          RESOURCE
         3 PDB_DBA                        CONNECT
         3 PM                             CONNECT
         3 PM                             RESOURCE
         3 SCOTT                          CONNECT
         3 SCOTT                          RESOURCE
         3 SH                             RESOURCE

19 rows selected.
```

Who Needs 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.
```

Feel free to explain why you need the READ ANY TABLE privilege

If you cannot explain it ... you don't need it

Excessive Privileges (1:2)

- Does every user connecting to an Oracle Database need EXECUTE privilege on these 187 packages?
- The answer is clearly no

```
SQL> SELECT DISTINCT table_name AS PACKAGE_NAME
  2  FROM cdb_tab_privs
  3  WHERE grantee = 'PUBLIC'
  4  AND table_name LIKE 'DBMS%'
  5  AND owner IN ('SYS', 'XDB')
  6* ORDER BY 1;

PACKAGE_NAME
------------------------------
DBMSOUTPUT_LINESARRAY
DBMS_ADDM
DBMS_ADVISOR
DBMS_APPLICATION_INFO
DBMS_APP_CONT_PRVT
DBMS_AQJMS
DBMS_AQ_EXP_CMT_TIME_TABLES
DBMS_AQ_EXP_DEQUEUELOG_TABLES
DBMS_AQ_EXP_HISTORY_TABLES
DBMS_AQ_EXP_INDEX_TABLES
DBMS_AQ_EXP_QUEUES
DBMS_AQ_EXP_QUEUE_TABLES
DBMS_AQ_EXP_SIGNATURE_TABLES
DBMS_AQ_EXP_SUBSCRIBER_TABLES
DBMS_AQ_EXP_TIMEMGR_TABLES
DBMS_AQ_IMP_INTERNAL
DBMS_AQ_INV
```

```
PACKAGE_NAME
------------------------------
DBMS_ASSERT
DBMS_AUTO_REPORT
DBMS_AUTO_TASK
DBMS_AW
DBMS_AW$_COLUMNLIST_T
DBMS_AW$_DIMENSION_SOURCES_T
DBMS_AW$_DIMENSION_SOURCE_T
DBMS_AW_EXP
DBMS_AW_STATS
DBMS_AW_XML
DBMS_CDC_DPUTIL
DBMS_CDC_EXPDP
DBMS_CDC_EXPVDP
DBMS_CDC_IMPDP
DBMS_CDC_ISUBSCRIBE
DBMS_CDC_SUBSCRIBE
DBMS_COMPRESSION
DBMS_CREDENTIAL
DBMS_CRYPTO_TOOLKIT
DBMS_CUBE
DBMS_CUBE_ADVISE
DBMS_CUBE_ADVISE_SEC
DBMS_CUBE_EXP
DBMS_CUBE_LOG
DBMS_CUBE_UTIL
DBMS_CUBE_UTIL_DFLT_MSR_R
DBMS_CUBE_UTIL_DFLT_MSR_T
DBMS_CUBE_UTIL_EXT_MD_R
DBMS_CUBE_UTIL_EXT_MD_T
DBMS_DATAPUMP
DBMS_DATA_MINING
DBMS_DATA_MINING_TRANSFORM
DBMS_DB_VERSION
```

```
PACKAGE_NAME
------------------------------
DBMS_DDL
DBMS_DEBUG
DBMS_DEBUG_JDWP
DBMS_DEBUG_JDWP_CUSTOM
DBMS_DEBUG_VC2COLL
DBMS_DESCRIBE
DBMS_DIMENSION
DBMS_DM_MODEL_EXP
DBMS_DM_MODEL_IMP
DBMS_EDITIONS_UTILITIES
DBMS_EPG
DBMS_ERRLOG
DBMS_EXPORT_EXTENSION
DBMS_FBT
DBMS_FILE_GROUP_EXP
DBMS_FILE_GROUP_IMP
DBMS_FREQUENT_ITEMSET
DBMS_HEAT_MAP
DBMS_HS_PARALLEL
DBMS_ILM
DBMS_ILM_ADMIN
DBMS_INDEX_UTL
DBMS_IOT
DBMS_ITRIGGER_UTL
DBMS_JAVA
DBMS_JOB
DBMS_JOB$
DBMS_LCR
DBMS_LDAP
DBMS_LDAP_UTL
DBMS_LOB
DBMS_LOBUTIL
DBMS_LOBUTIL_DEDUPSET_T
```

Excessive Privileges (2:2)

```
PACKAGE_NAME
------------------------------
DBMS_LOBUTIL_INODE_T
DBMS_LOBUTIL_LOBEXTENTS_T
DBMS_LOBUTIL_LOBEXTENT_T
DBMS_LOBUTIL_LOBMAP_T
DBMS_LOGREP_EXP
DBMS_LOGREP_IMP
DBMS_LOGSTDBY_CONTEXT
DBMS_METADATA
DBMS_METADATA_DIFF
DBMS_NETWORK_ACL_UTILITY
DBMS_OBFUSCATION_TOOLKIT
DBMS_OBJECTS_UTILS
DBMS_ODCI
DBMS_OUTPUT
DBMS_PARALLEL_EXECUTE
DBMS_PART
DBMS_PCLXUTIL
DBMS_PICKLER
DBMS_PREDICTIVE_ANALYTICS
DBMS_PREPROCESSOR
DBMS_PROFILER
DBMS_PSP
DBMS_RANDOM
DBMS_REFRESH
DBMS_REFRESH_EXP_LWM
DBMS_REFRESH_EXP_SITES
DBMS_REPCAT_EXP
DBMS_REPCAT_INSTANTIATE
DBMS_REPCAT_RGT_EXP
DBMS_REPORT
DBMS_RESOURCE_MANAGER
DBMS_RESOURCE_MANAGER_PRIVS
DBMS_RESULT_CACHE_API
```

```
PACKAGE_NAME
------------------------------
DBMS_RMGR_GROUP_EXPORT
DBMS_RMGR_PACT_EXPORT
DBMS_RMGR_PLAN_EXPORT
DBMS_RMIN
DBMS_ROWID
DBMS_RULE
DBMS_RULEADM_INTERNAL
DBMS_RULE_ADM
DBMS_RULE_EXP_EV_CTXS
DBMS_RULE_EXP_RULES
DBMS_RULE_EXP_RULE_SETS
DBMS_RULE_EXP_UTLI
DBMS_RULE_IMP_OBJ
DBMS_SCHEDULER
DBMS_SCHED_ATTRIBUTE_EXPORT
DBMS_SCHED_CHAIN_EXPORT
DBMS_SCHED_CLASS_EXPORT
DBMS_SCHED_CREDENTIAL_EXPORT
DBMS_SCHED_EXPORT_CALLOUTS
DBMS_SCHED_FILE_WATCHER_EXPORT
DBMS_SCHED_JOB_EXPORT
DBMS_SCHED_PROGRAM_EXPORT
DBMS_SCHED_SCHEDULE_EXPORT
DBMS_SCHED_WINDOW_EXPORT
DBMS_SCHED_WINGRP_EXPORT
DBMS_SCN
DBMS_SESSION
DBMS_SNAPSHOT
DBMS_SNAPSHOT_UTL
DBMS_SPACE
DBMS_SPD
DBMS_SPM
DBMS_SQL
```

```
PACKAGE_NAME
------------------------------
DBMS_SQLDIAG
DBMS_SQLPA
DBMS_SQLTUNE
DBMS_SQLTUNE_UTIL2
DBMS_SQL_MONITOR
DBMS_SQL_TRANSLATOR
DBMS_SQL_TRANSLATOR_EXPORT
DBMS_STANDARD
DBMS_STATS
DBMS_STAT_FUNCS
DBMS_STAT_FUNCS_AUX
DBMS_STREAMS
DBMS_STREAMS_PUB_RPC
DBMS_SUMMARY
DBMS_SUM_RWEQ_EXPORT
DBMS_SYNC_REFRESH
DBMS_TRACE
DBMS_TRANSACTION
DBMS_TRANSFORM_EXIMP
DBMS_TYPES
DBMS_UTILITY
DBMS_WARNING
DBMS_XA
DBMS_XA_XID
DBMS_XA_XID_ARRAY
DBMS_XMLGEN
DBMS_XMLQUERY
DBMS_XMLSAVE
DBMS_XMLSTORE
DBMS_XPLAN
DBMS_XPLAN_TYPE
DBMS_XPLAN_TYPE_TABLE
DBMS_XQUERY
```

```
PACKAGE_NAME
------------------------------
DBMS_XQUERYINT
DBMS_XSLPROCESSOR
DBMS_XS_NSATTR
DBMS_XS_NSATTRLIST
DBMS_XS_SESSIONS
DBMS_ZHELP_IR
UTL_ALL_IND_COMPS
UTL_BINARYINPUTSTREAM
UTL_BINARYOUTPUTSTREAM
UTL_CALL_STACK
UTL_CHARACTERINPUTSTREAM
UTL_CHARACTEROUTPUTSTREAM
UTL_COLL
UTL_COMPRESS
UTL_ENCODE
UTL_FILE
UTL_GDK
UTL_HTTP
UTL_I18N
UTL_IDENT
UTL_INADDR
UTL_LMS
UTL_MAIL_INTERNAL
UTL_MATCH
UTL_NLA
UTL_NLA_ARRAY_DBL
UTL_NLA_ARRAY_FLT
UTL_NLA_ARRAY_INT
UTL_PG
UTL_RAW
UTL_REF
UTL_SMTP
UTL_TCP
UTL_URL
```

Statistics Collection

Statistics Collection

- Some of the stats collected by use of the DBMS_STATS package are collected automatically
- The ones most important at installation time are only collected when you manually initiate collection
- The stats we are focusing on here are
  - System Statistics
  - Fixed Object Statistics
  - Data Dictionary Statistics
  - Processing Rates
- Other statistics should be address on an ongoing basis with a production system through manual collection or through the use of DBMS_SCHEDULER jobs
  - Copying or setting table statistics immediately following partition creation
  - Copying or setting index statistics immediately following partition creation

System Statistics

- The Oracle Database, by default, does not collect system stats

```
SQL> exec dbms_stats.gather_system_stats('INTERVAL', 15);

SQL> SELECT * FROM sys.aux_stats$;

SNAME            PNAME                PVAL1 PVAL2
---------------- -------------- ---------- -----------------
SYSSTATS_INFO    STATUS                     COMPLETED
SYSSTATS_INFO    DSTART                     05-27-2015 09:45
SYSSTATS_INFO    DSTOP                      05-27-2015 09:51
SYSSTATS_INFO    FLAGS                   0
SYSSTATS_MAIN    CPUSPEEDNW           3010
SYSSTATS_MAIN    IOSEEKTIM              10
SYSSTATS_MAIN    IOTFRSPEED           4096
SYSSTATS_MAIN    SREADTIM            3.862
SYSSTATS_MAIN    MREADTIM            1.362
SYSSTATS_MAIN    CPUSPEED             2854
SYSSTATS_MAIN    MBRC                   17
SYSSTATS_MAIN    MAXTHR
SYSSTATS_MAIN    SLAVETHR
```

- Or Fixed Object Stats
- Or Dictionary Stats

Automatic Workload Repository Enhancement

- Automatic Workload Repository (AWR), by default, collects statistics once each hour and retains them for 7 days
- This is totally inadequate for almost any real-world requirement to use an AWR Report
  - An Oracle Database customer should be able to compare periods with the current period and the prior period is often the previous week or month
- Tom Kyte, years ago with StatsPack wrote that collection should be every 15-20 minutes and retention to 31 days
- The following code alters collection to match this recommendation and well as altering the "top n SQL" collection to 50,000
- The last value in the following code demo is the database's DBID

```
exec dbms_workload_repository.modify_snapshot_settings((24*60*31), 20, 50000, 428676178);
```

User Creation

Proxy Users (1:3)

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

About Proxy Authentication

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

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

- Here's what Tom Kyte wrote ...

and we said...

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

Proxy Users (2:3)

- ... and proxy users cannot be spoofed

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

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

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

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

The nice thing about this is:

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

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

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

Proxy Users (3:3)

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

User created.

SQL> 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
```

Oracle Cloud Impact

Changing The Conversation

- The Oracle Cloud completely changes the conversation in the same way that Undo Tablespaces, ASM, and engineered systems like Exadata and ODA changed the conversation
- The UNDO tablespaces replaced rollback segments because Oracle saw an opportunity to automate what was a thankless DBA task ... determining the number of rollback segments, their size, and the now deprecated "SET TRANSACTION USE ROLLBACK SEGMENT"
- ASM allowed us to take control of database storage
- And Exadatas and ODAs was Oracle's move to further empower DBAs by giving them infrastructure engineered and optimized for Oracle database workloads
- The Oracle Cloud extends the engineered system optimization to the entire stack
  - networking
  - storage
  - backups

Wrap Up

Conclusion

- The presentation covers a subset of the Oracle Database's default configurations that will not give you the optimum
  - Stability
  - Security
  - Scalability

  you need for your environment and for your applications
- You can invest a large number of hours, each week, trying to fix things one-at-a-time or you can invest some time, up-front, during installation configuring your environment correctly before you make it available for customers
- The Oracle Cloud can quickly address

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

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