

Integrating the Oracle Database Appliance with the Sun ZFS Storage Appliance to Achieve High Availability and Security

Agenda



- Introductions
- Executive Summary
- Puzzle Pieces (HA)
- ODA
 - What and Why
 - Installation
 - Value Adds
- ZFS File System
 - Pooling
 - Redundancy
- ZFS Storage Appliance
- Questions

Daniel A. Morgan



Oracle ACE Director



Consultant to Harvard University



University of Washington Oracle Instructor, ret.



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- Upcoming Presentations

- Feb 24-15: Rocky Mountain Oracle Users Group
- Mar 13-14: Utah Oracle Users Group
- Apr 16-18: Oracle User Group Norway
- Apr 19-20: Oracle User Group Finland
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- May 15 Oracle User Group Azerbaijan
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Official Beta Site

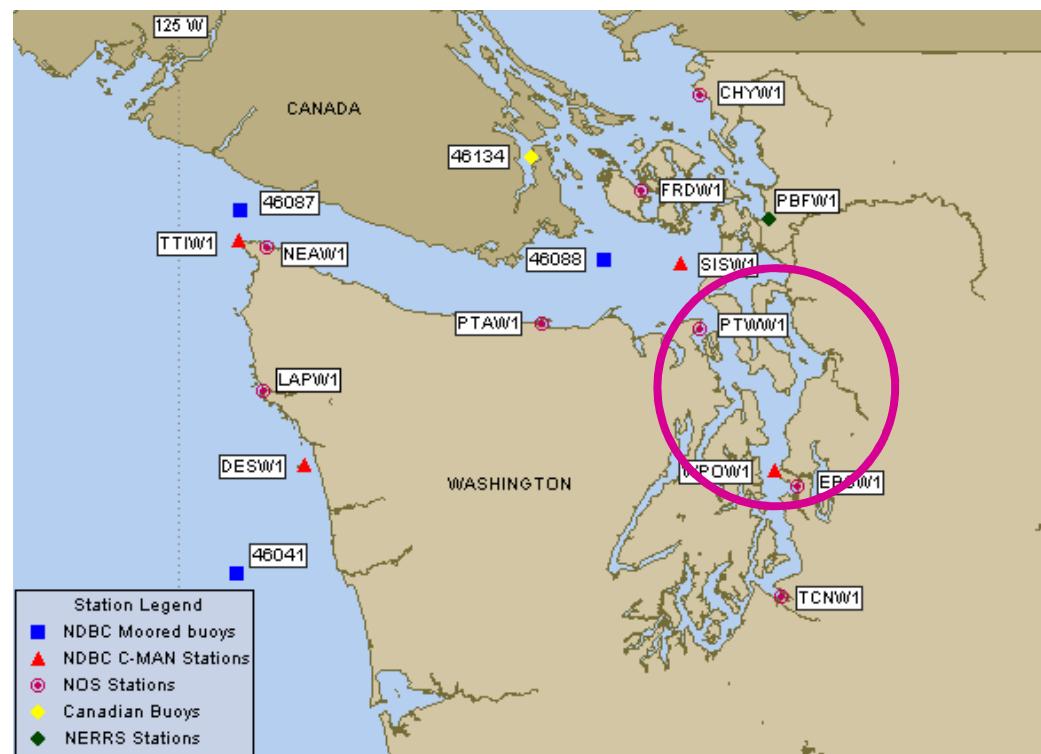


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cd \$MORGAN_HOME



cd \$MORGAN_HOME



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My Sled



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Travels



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LAD Tour: Machu Picchu Peru



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Eyjafjallajökull



Time	Flight	Gate	Destination	
				17:44
0630	DY1800		Malaga	
1710	BLX692	46	Goteborg	Gate closed
1710	SK811		London/Heathrow	Cancelled
1715	SK841		Zurich	Cancelled
1715	AY660		Helsinki	Cancelled
1720	QH4796		Bilfond	Cancelled
1725	DY1494		Paris/Orly	Cancelled
1725	KL1148		Amsterdam	Cancelled
1725	KQ1148		Amsterdam	Cancelled
1730	SK461		Kopenhagen	Cancelled
1740	DY1866		Pisa	Cancelled
1750	DY3232		Kopenhagen	Cancelled
1805	LH3145		Munchen	Cancelled
1805	SK3681		Munchen	Cancelled
1805	SK1465		Kopenhagen	Cancelled
1810	DY1306		London/Gatwick	Cancelled
1815	DY1978		Beograd	Cancelled
1820	SK1484	36	Stockholm	Cancelled
1825	DY1108		Berlin/Schoenefeld	Cancelled
1825	BA8272		Aarhus	Cancelled
1830	DY3774		Stockholm	Cancelled
1845	FI325	46	Reykjavik	New time 1925
1855	SK3621		Frankfurt	Cancelled
1855	LH3135		Frankfurt	Cancelled
1855	SK6616	39	Helsinki	
1855	KF506	39	Helsinki	
1900	SK463		Kopenhagen	Cancelled
1905	DY1256		Amsterdam	Cancelled
1915	TP509		Lisboa	Cancelled
1915	DY1132		Dusseldorf	Cancelled
1920	WF336		Goteborg	Cancelled
1920	DY1352		Edinburgh	Cancelled
1920	SK3192		Goteborg	Cancelled
1920	QH4798		Bilfond	Cancelled

Fun things to not do in Iceland



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TOURIS tour booking - Step 1

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- 
The Full Circle Express.
- 
Grand tour around Iceland including the Westfjords.
- 
A real 4x4 highland adventure.
- 
South Iceland at leisure.
- 
Explore

::Tour Information

Tour: TT45
Volcano in Action - This tour is currently not available!

Season: All year
Departures: Daily
Departure times: 17:30
Duration: 6,5

Price info:

- Adults: € 55,00
- Age 12-17: € 27,50
- Age 3-11: € 0,00
- Age 0-2: € 0,00

* All prices are per person.
* Please select your details here to the right and click next to determine your total price.

Included in the price:

- Bus tour with English speaking guidance

::Your details

Date of tour:

Adults: Youth (12-17): Children (3-11): Infants (0-2):

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Executive Summary



- Never make a technology argument when a financial argument will suffice
 - Your CFO wants to talk about ROI not IOPS
 - Will this technology support our organization's needs?
 - Can we right-size it today and will it scale for tomorrow?
 - Does it meet our regulatory and compliance requirements?
 - What is involved in migrating current operations to it?
 - Can our existing team deploy and maintain it?
 - Can we find qualified technologists who already know it?
 - Can the vendor(s) involved fully support the tech stack?
 - How will this affect our customers?
 - How will this affect our financial position?
 - capital expense to obtain it
 - operating expense to maintain it
 - future retirement expense

Questions we as IT professionals must answer



- Why does deployment take so long and cost so much?
- Why are we spending so much on support?
- Why does patching so often break something else?
- Why do we spend so much time fighting fires?



IT infrastructure on a good day



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IT infrastructure meets a single point of failure

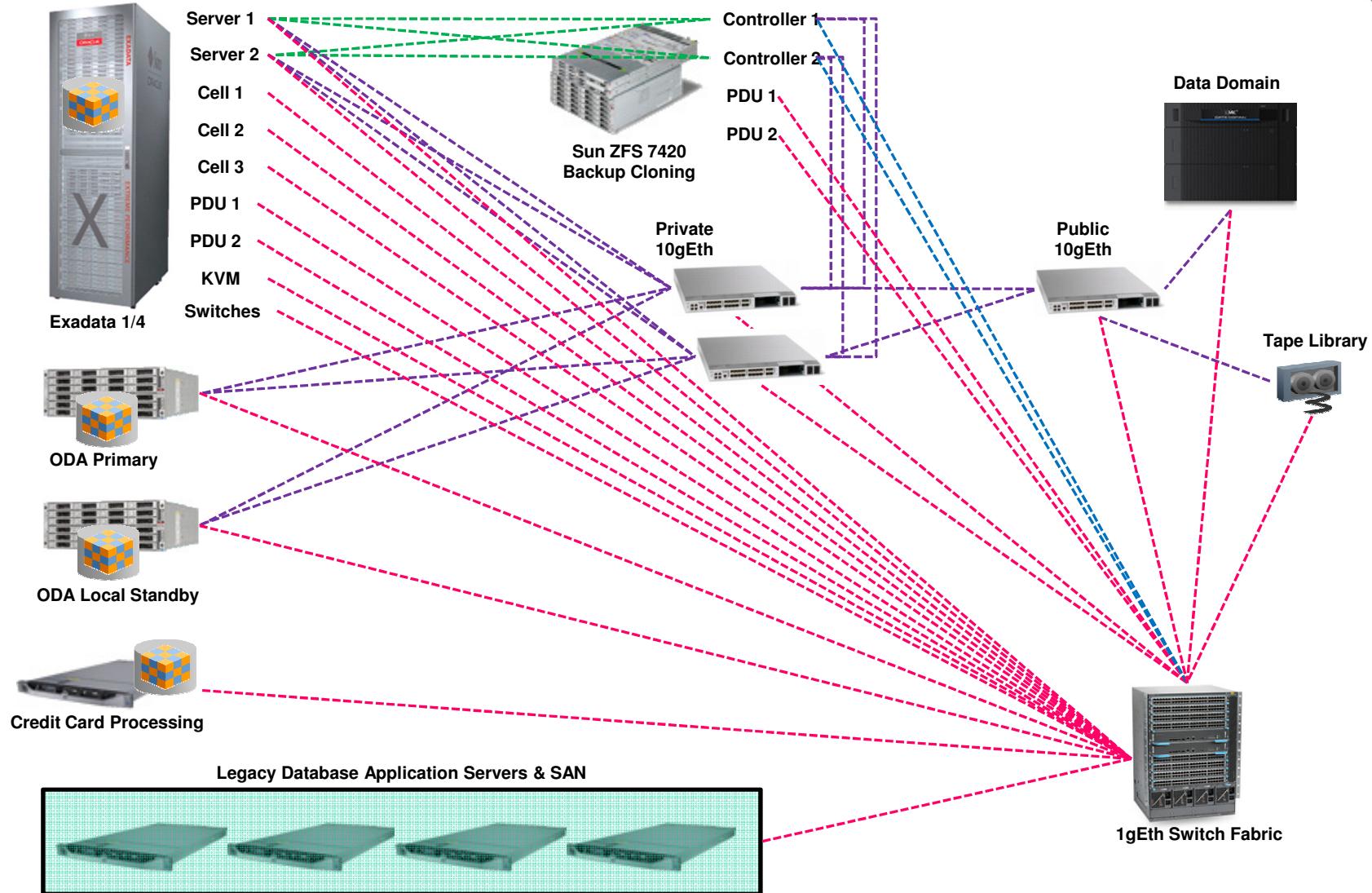


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Puzzle Pieces



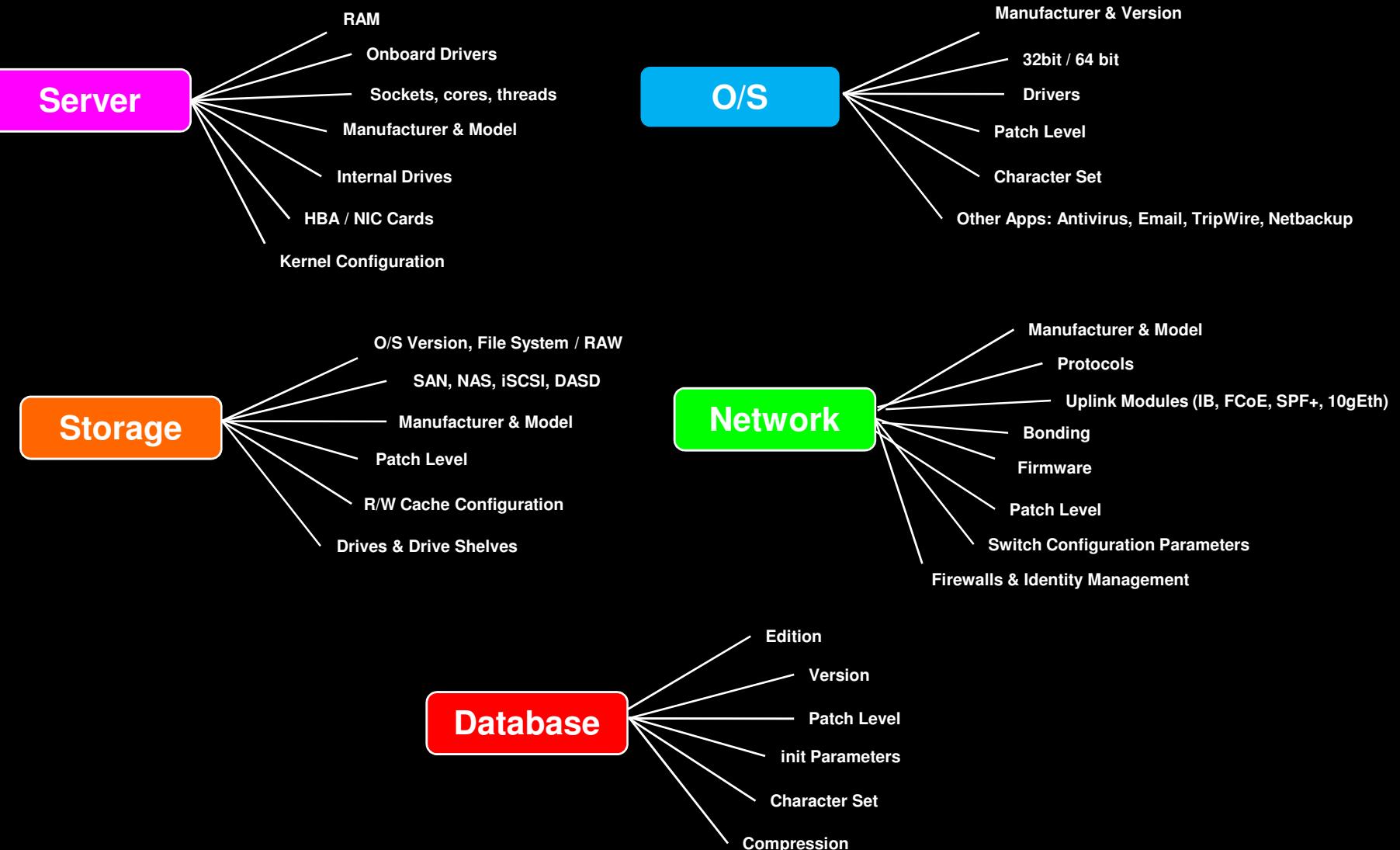
Each connection shown must be multiplexed and bonded

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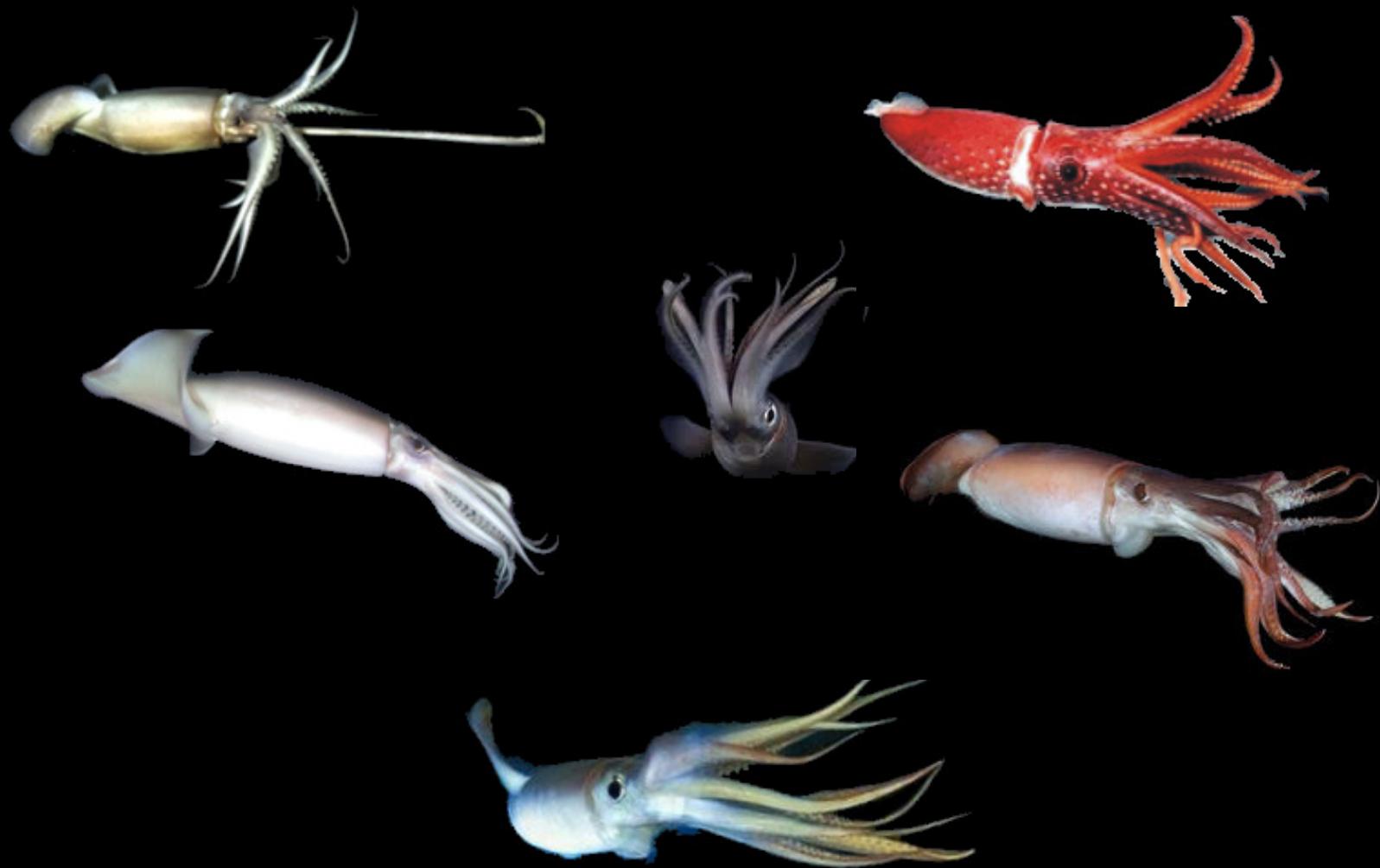
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Static Puzzle Pieces



Animated Puzzle Pieces



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It's hard to embrace a barrel of squid



Puzzle Pieces



- The decisions we've made in the past guarantee that
 - No one has ever built a RAC cluster with our configuration
 - No one has ever applied operating system and firmware patches to our configuration
 - No one has ever patched to our configuration
 - Oracle has never tested and certified our configuration
 - No one in support can exactly duplicate our environment



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LONELINESS

IF YOU FIND YOURSELF STRUGGLING WITH LONELINESS, YOU'RE NOT ALONE.
AND YET YOU ARE ALONE. SO VERY ALONE.

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The Solution

make different, and better, decisions

What is an ODA?



- An appliance
 - A single line on the invoice ... plus the power chords
 - But you get root and sys: The customer is in control
- Announced last year at OpenWorld
- Engineered two server RAC cluster in a 4U case
 - 24 CPU cores
 - 192 GB of RAM
 - 12 TB of direct attached storage with ASM triple mirroring
 - 2TB RAID mirrored disks for O/S and Oracle binaries
- One size fits all ... but ...
- License only the resources you need
- Cores licensed dictate all on-board Oracle licensing

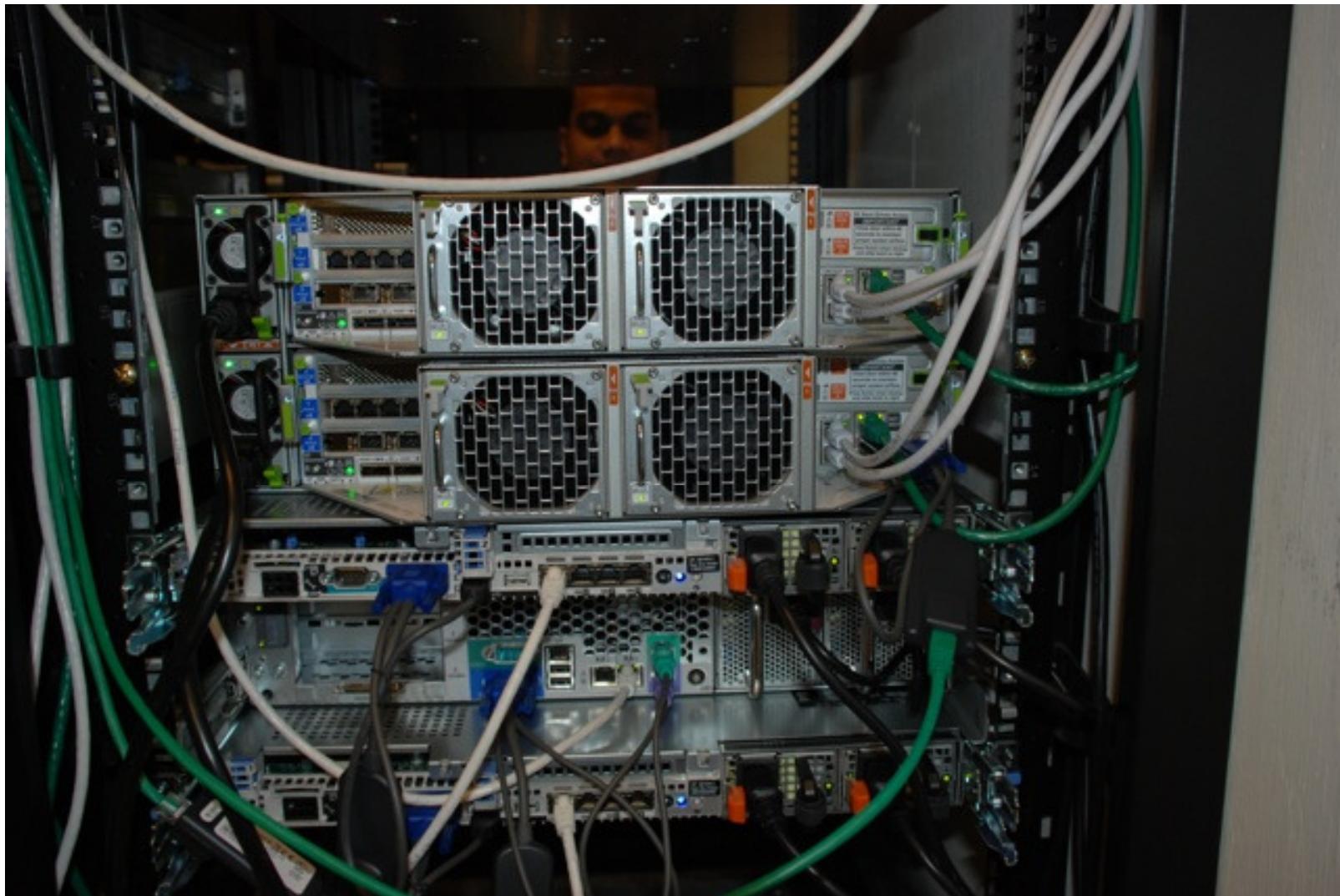
ODA in Pictures



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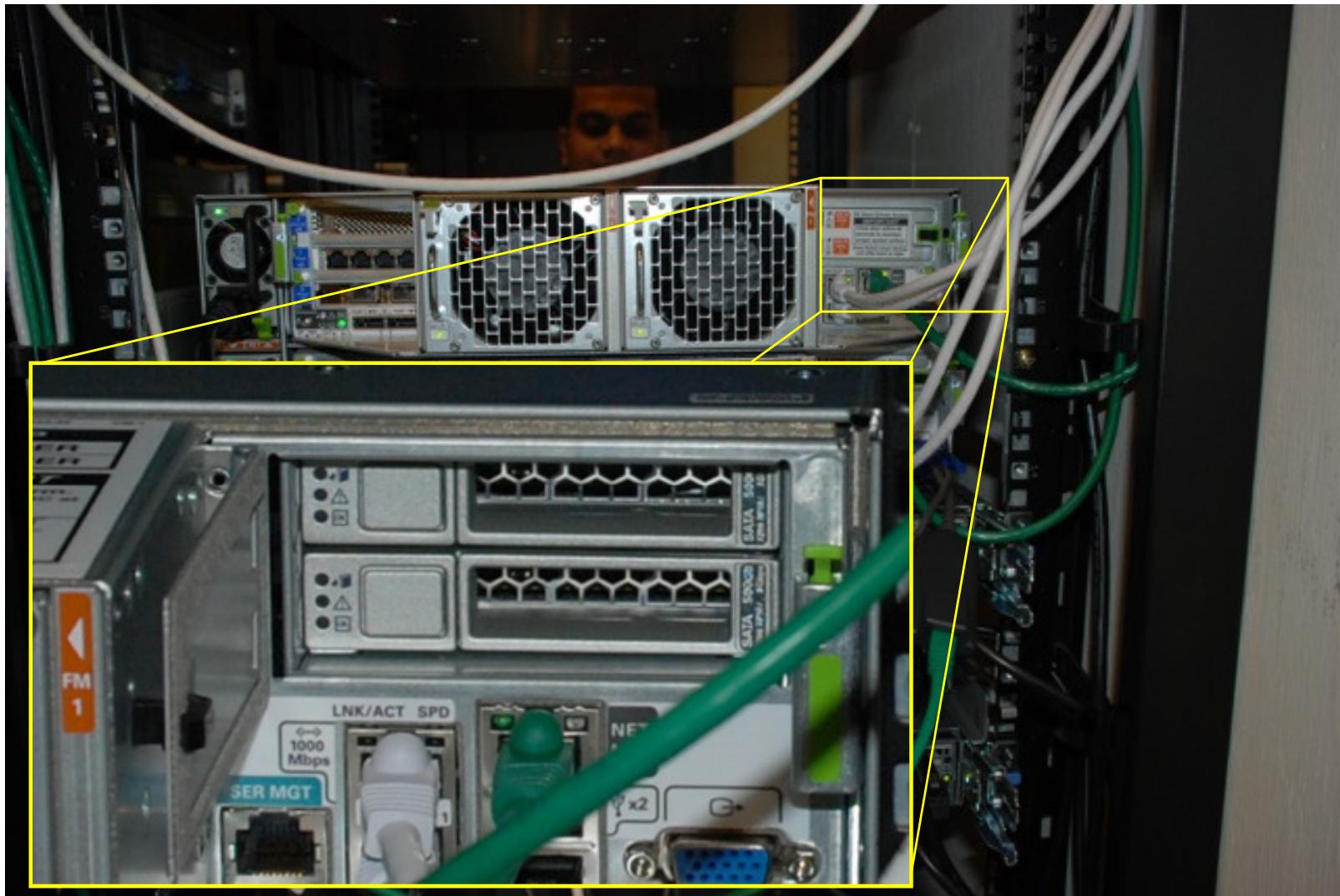
ODA in Pictures



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ODA in Pictures



Why an ODA?



- Minimize complexity from rack-and-stack through database deployment
- Fewer resources required to deploy
 - UNIX System Admins: not required
 - Network Admins: not required
 - Storage Admins: not required
- Ease of maintenance and patching
 - One patch combines O/S, drivers, networking, infrastructure
 - One patch database
- Supports multiple Oracle databases
- Petabyte storage available with ZFS
- Can form the basis for deploying HA applications in organizations that lack in-depth technical resources

No rolling patches ... and they are not childproof





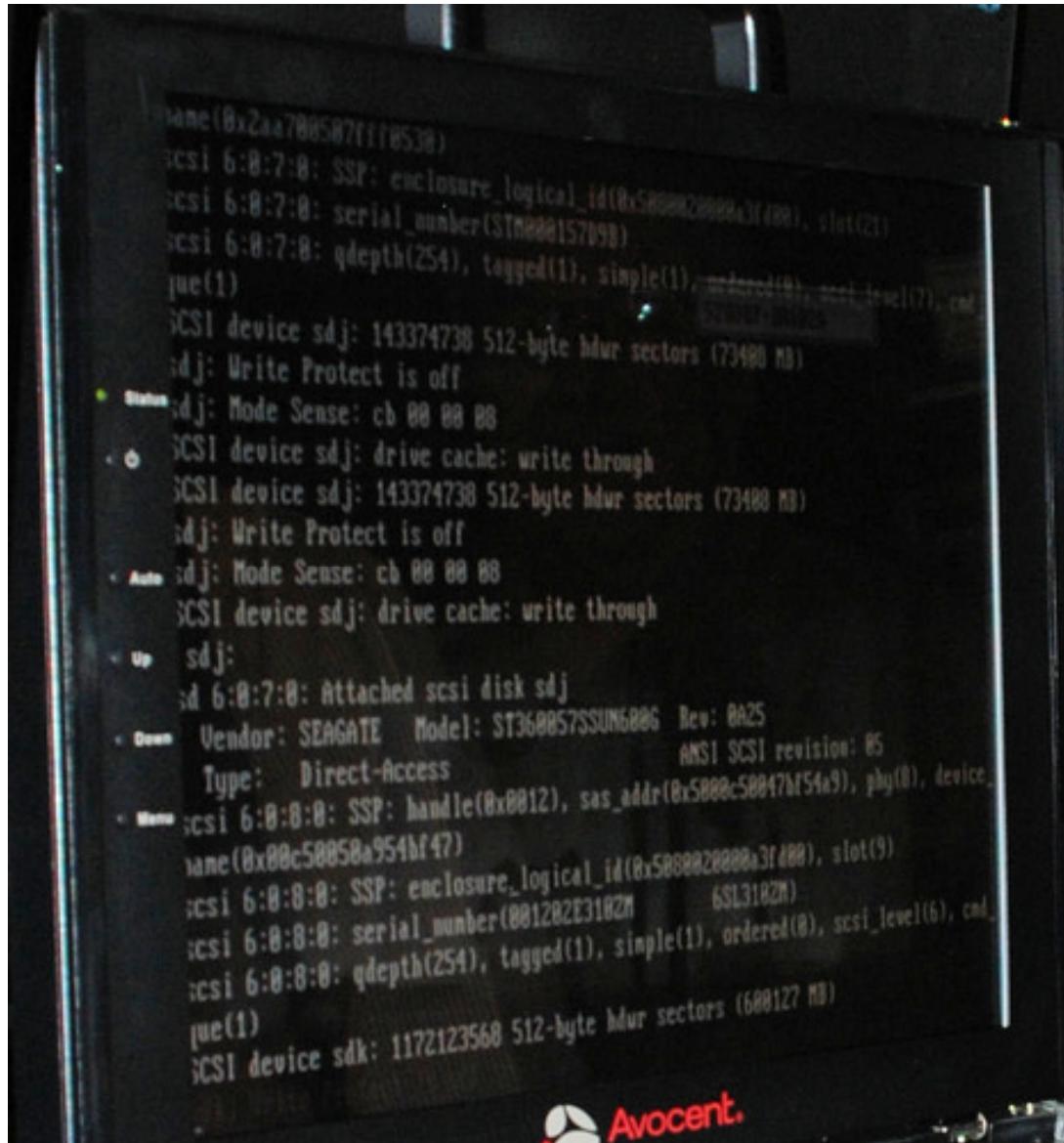
Discussion

Installation

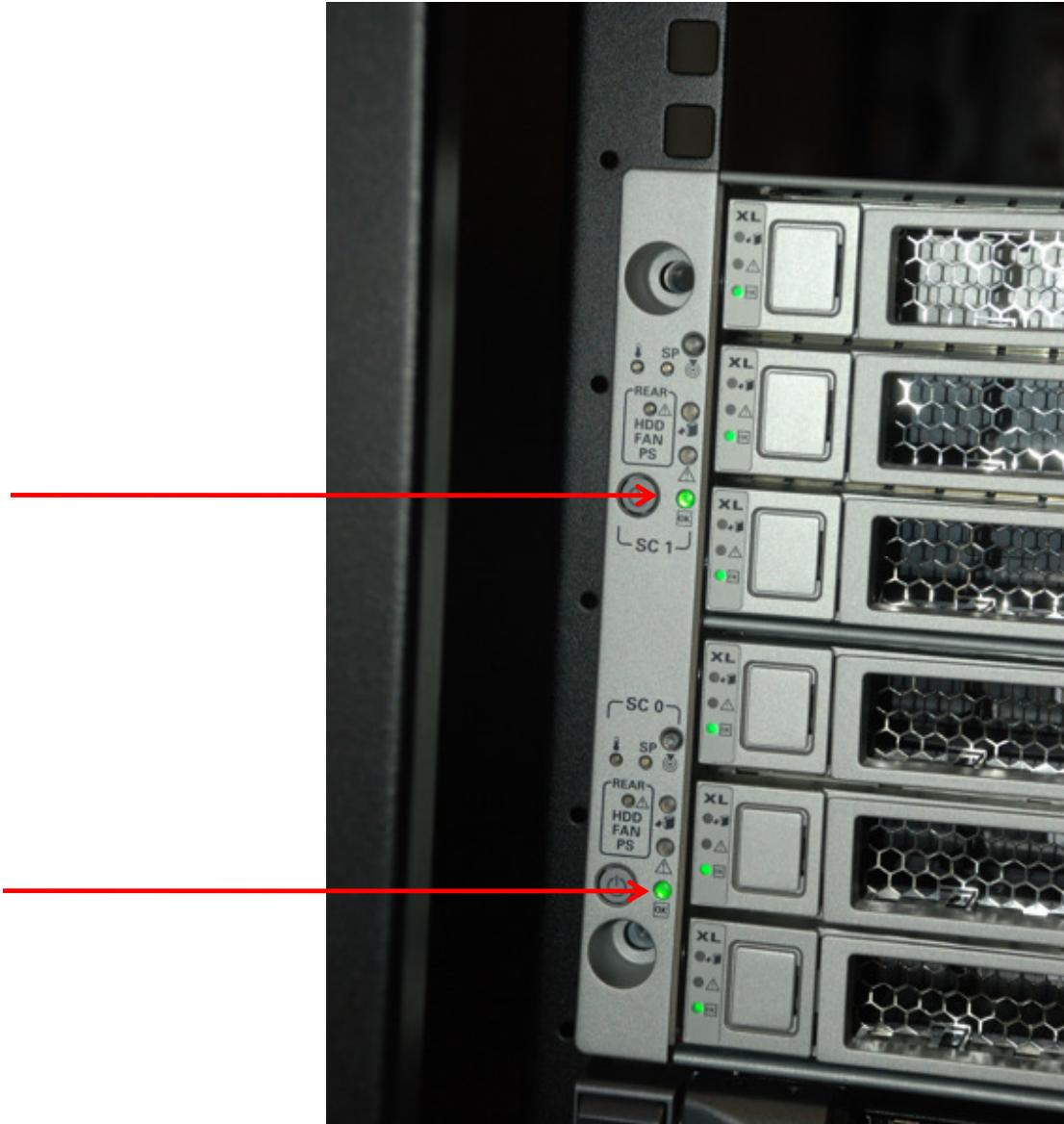
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Step 1: Power On



Step 2: Wait for OK Lights



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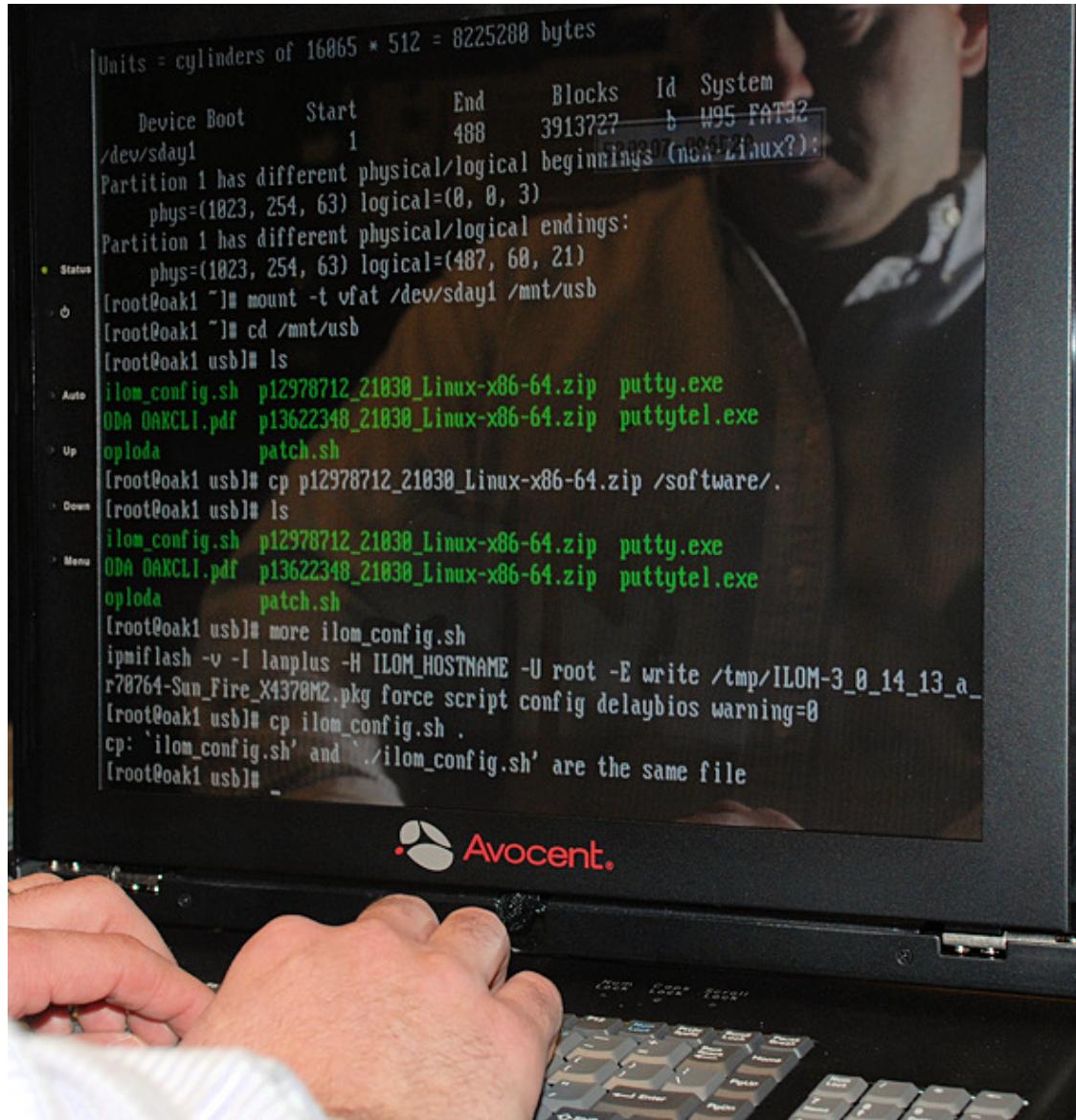
Step 3: Log In as root



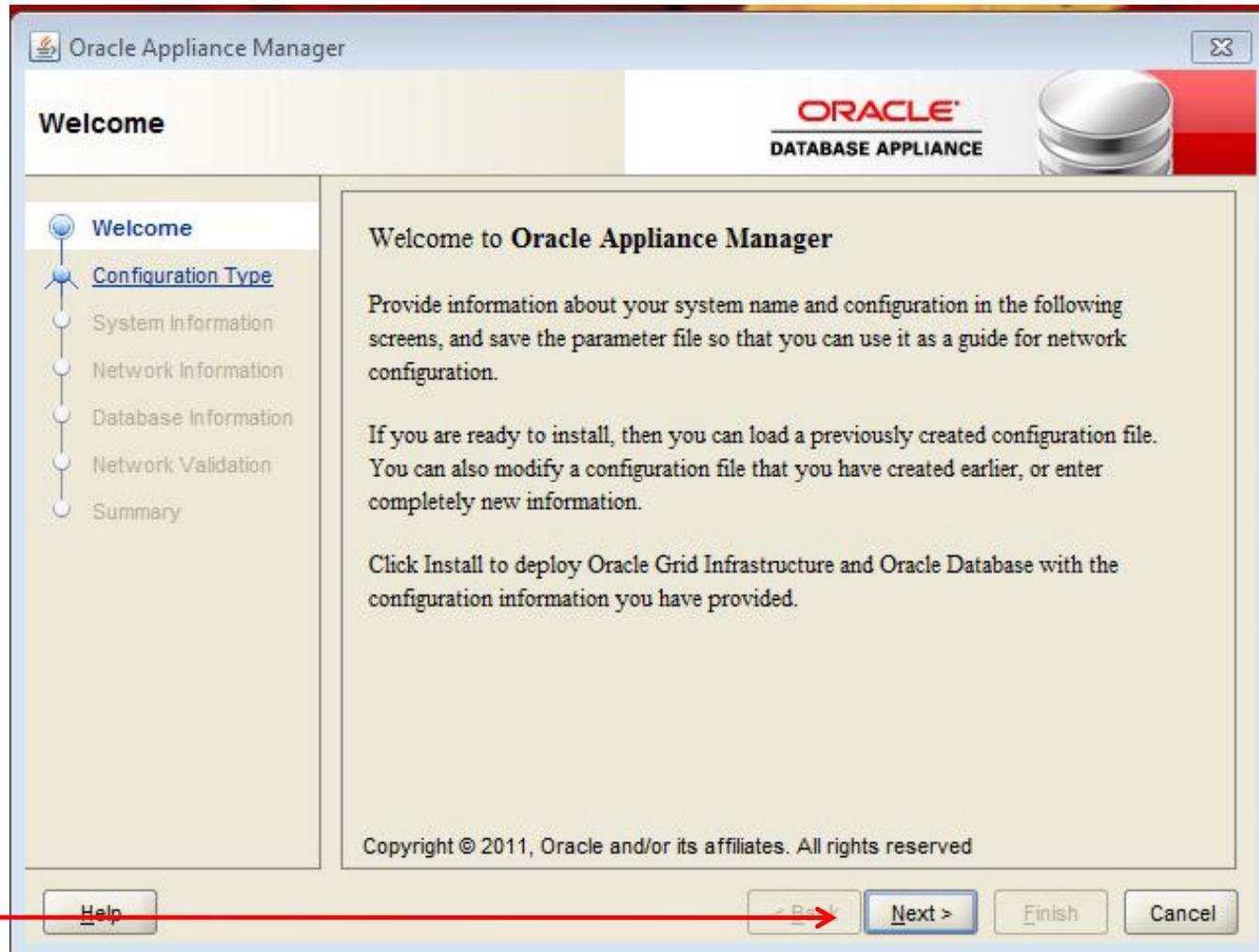
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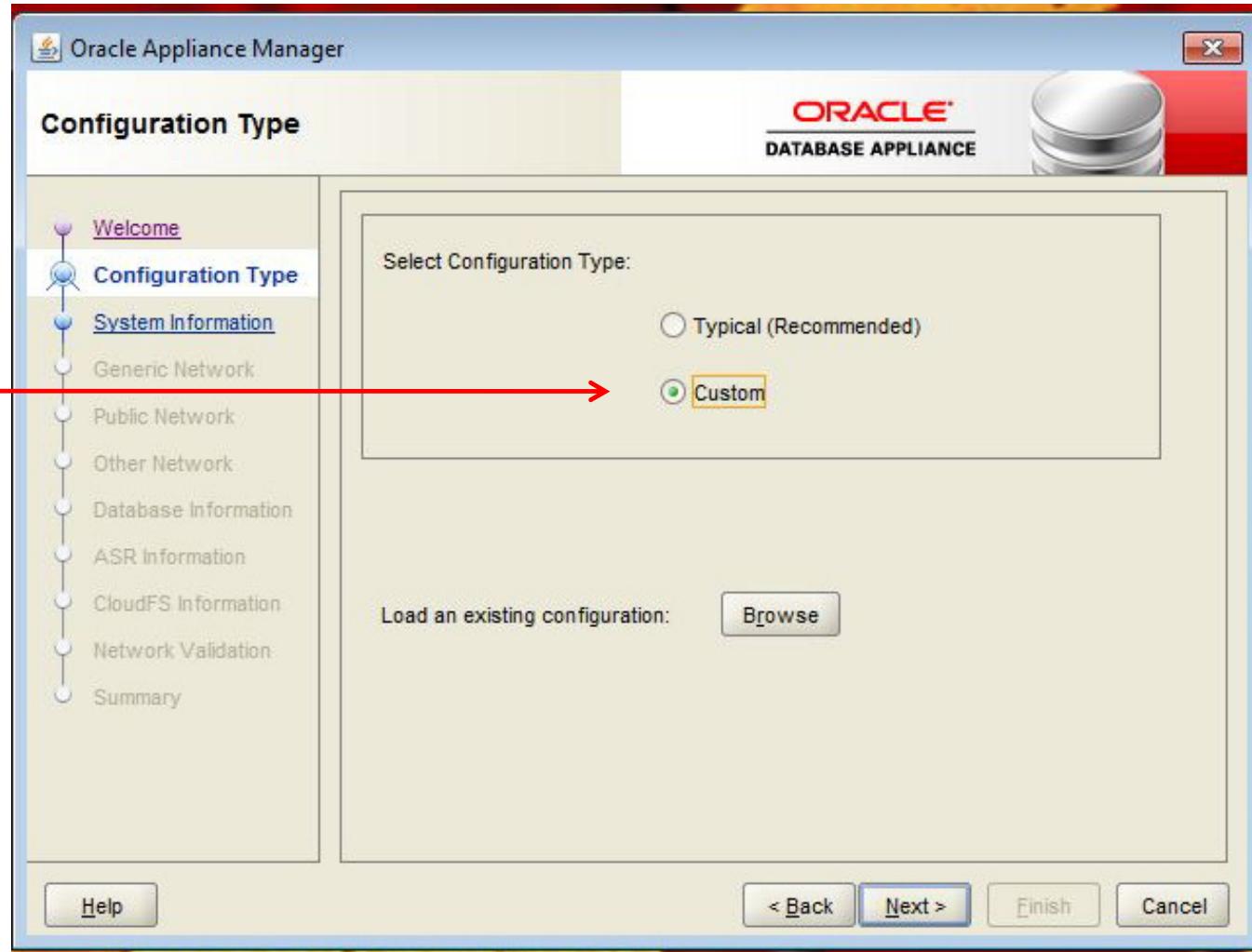
Step 5: Perform ILOM Configuration



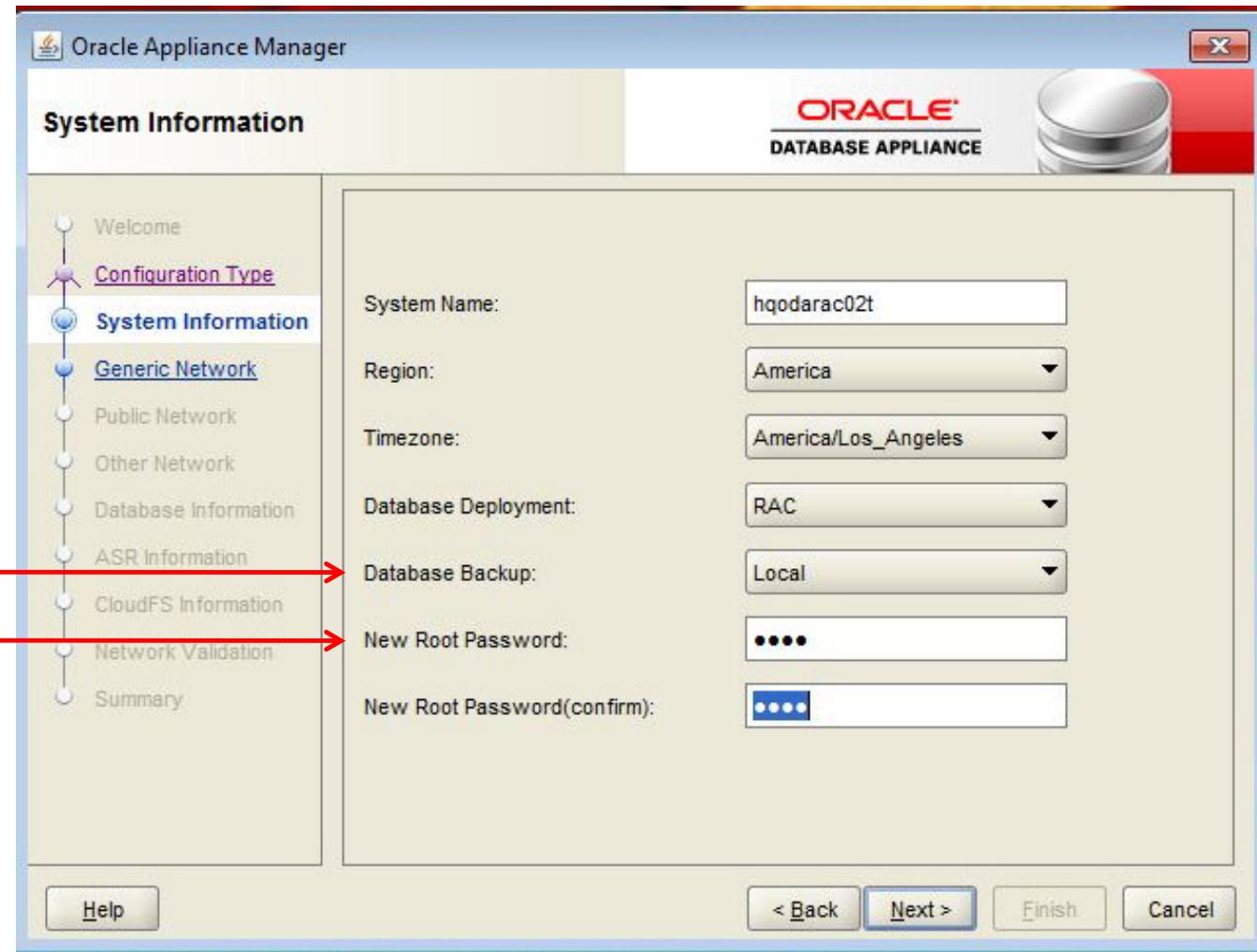
Install Screens: 1



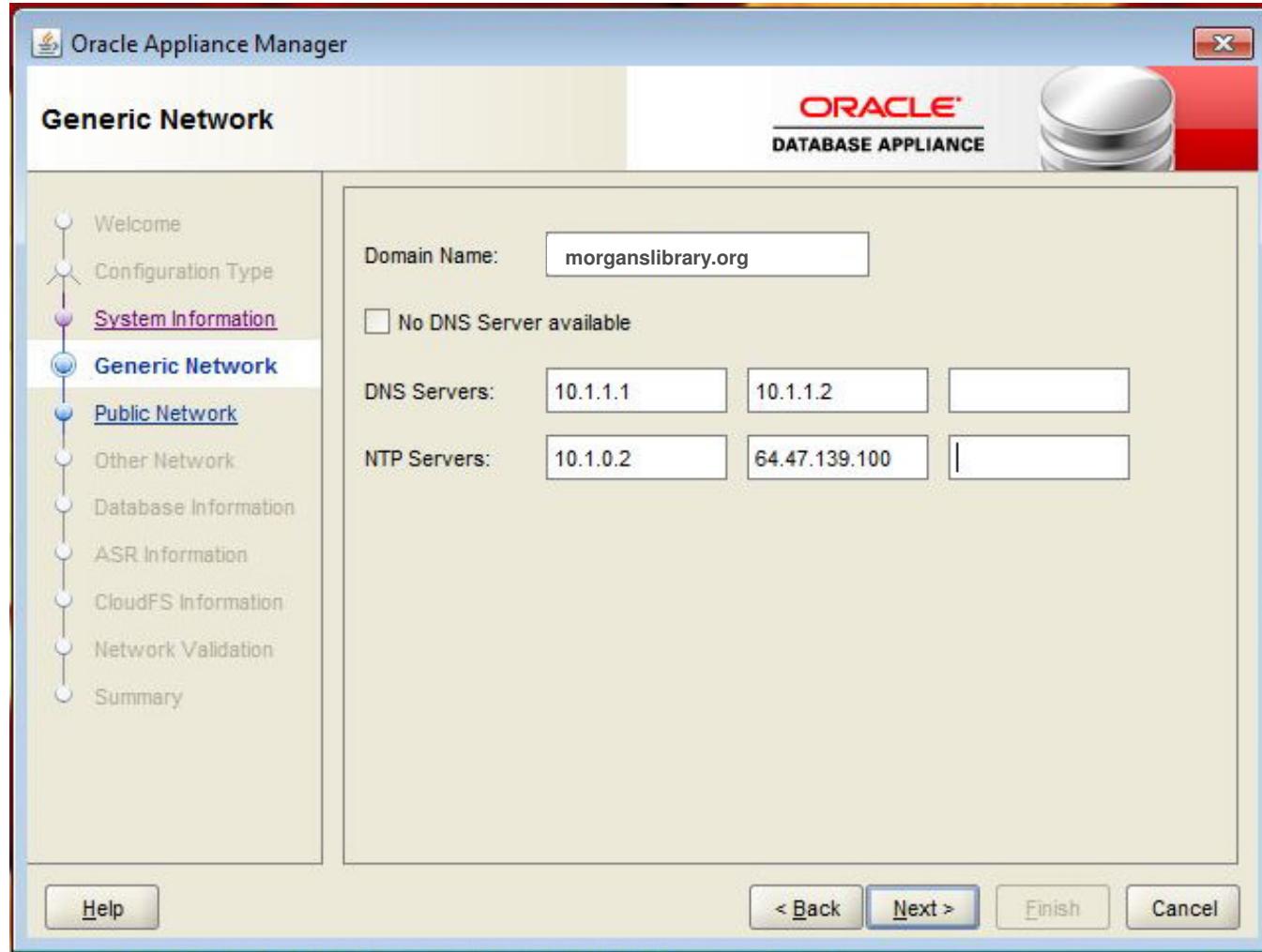
Install Screens: 2



Install Screens: 3



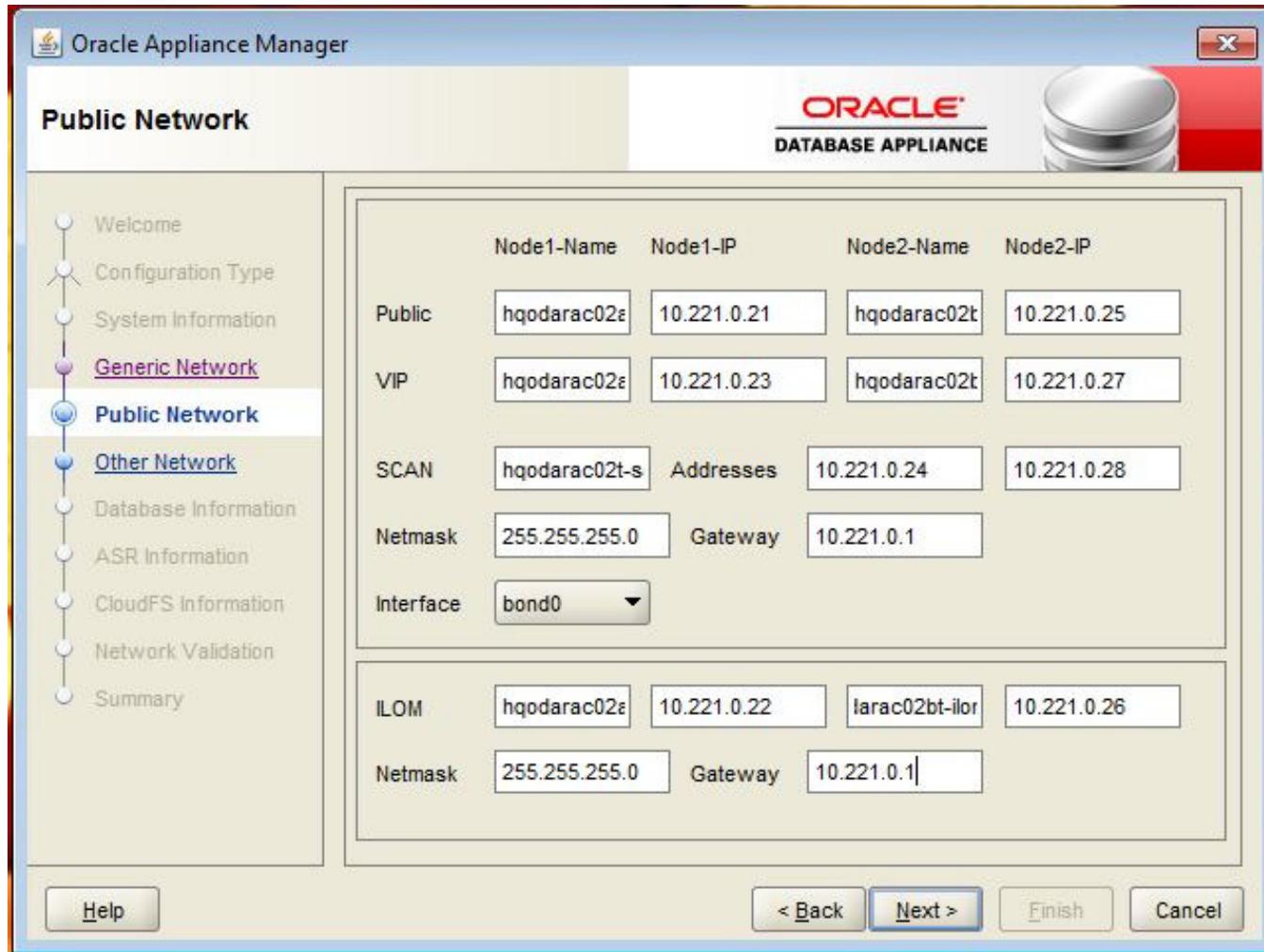
Install Screens: 4



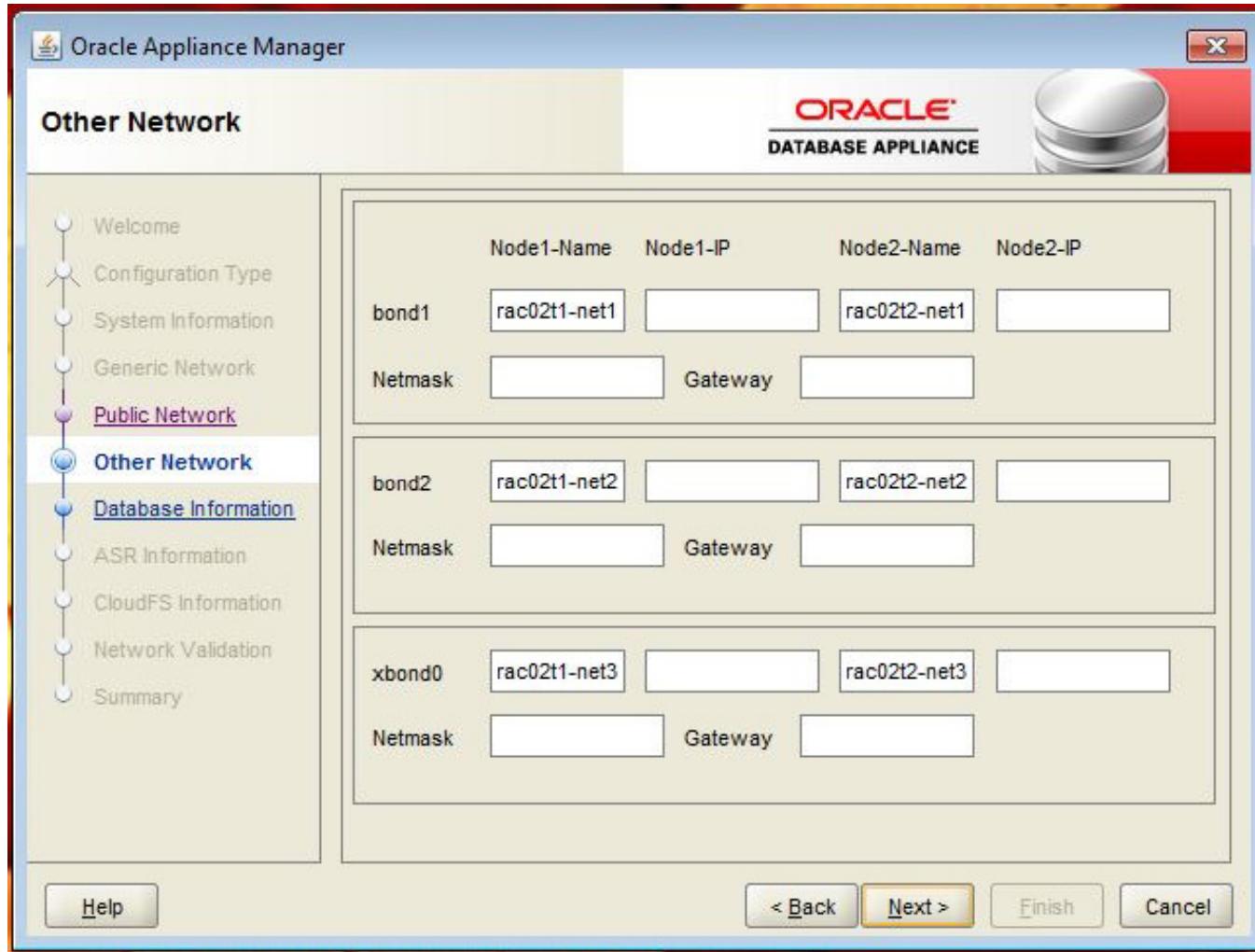
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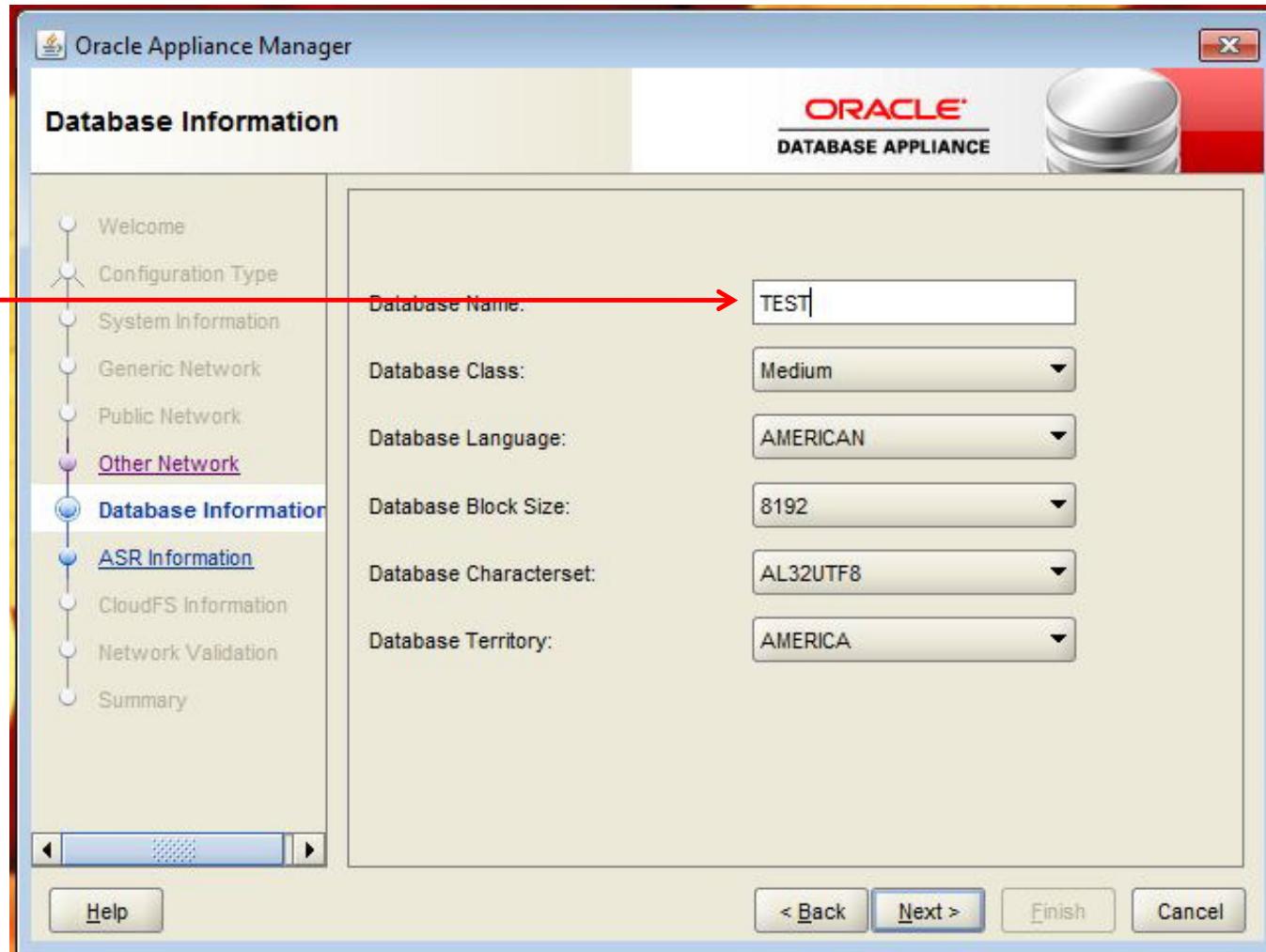
Install Screens: 5



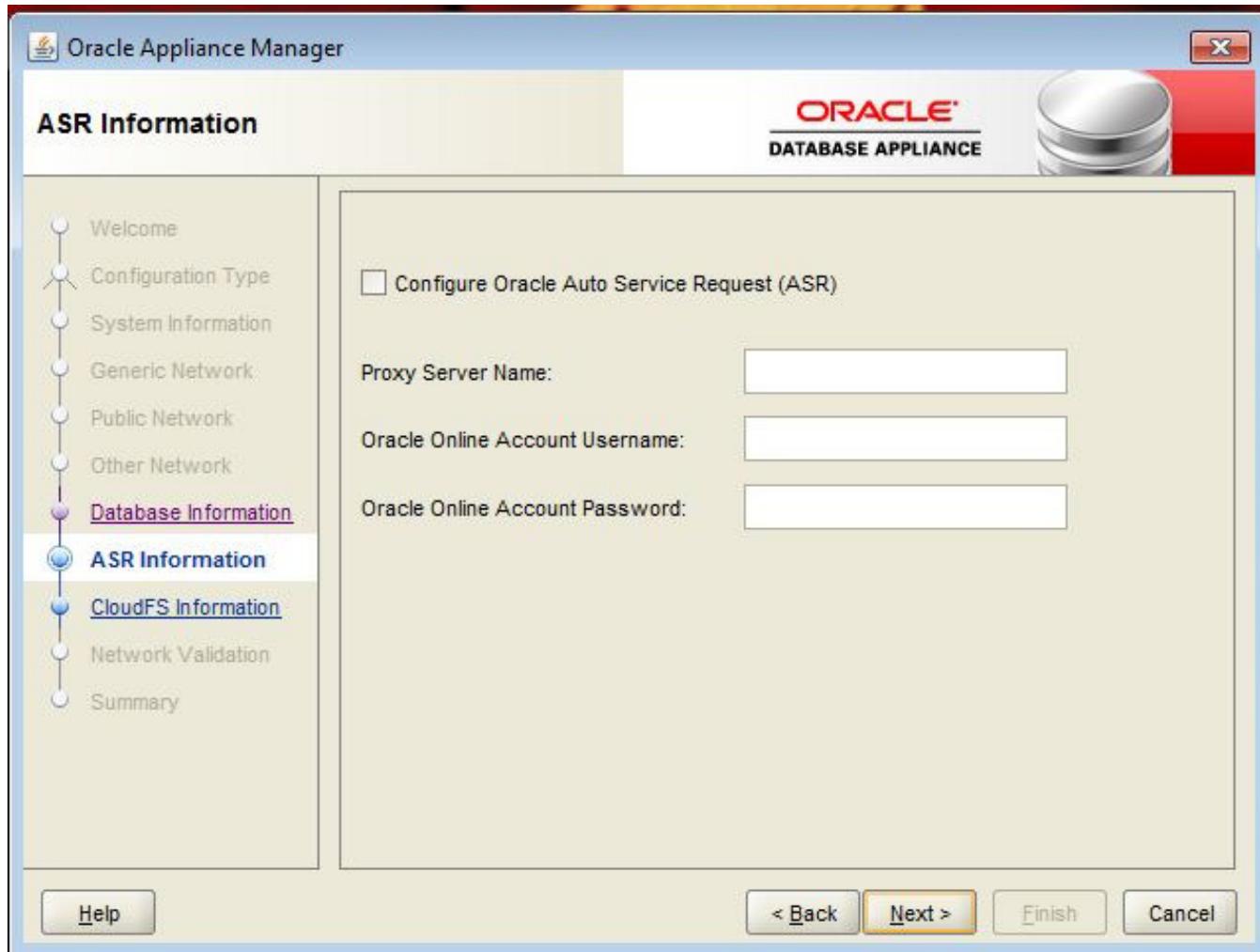
Install Screens: 6



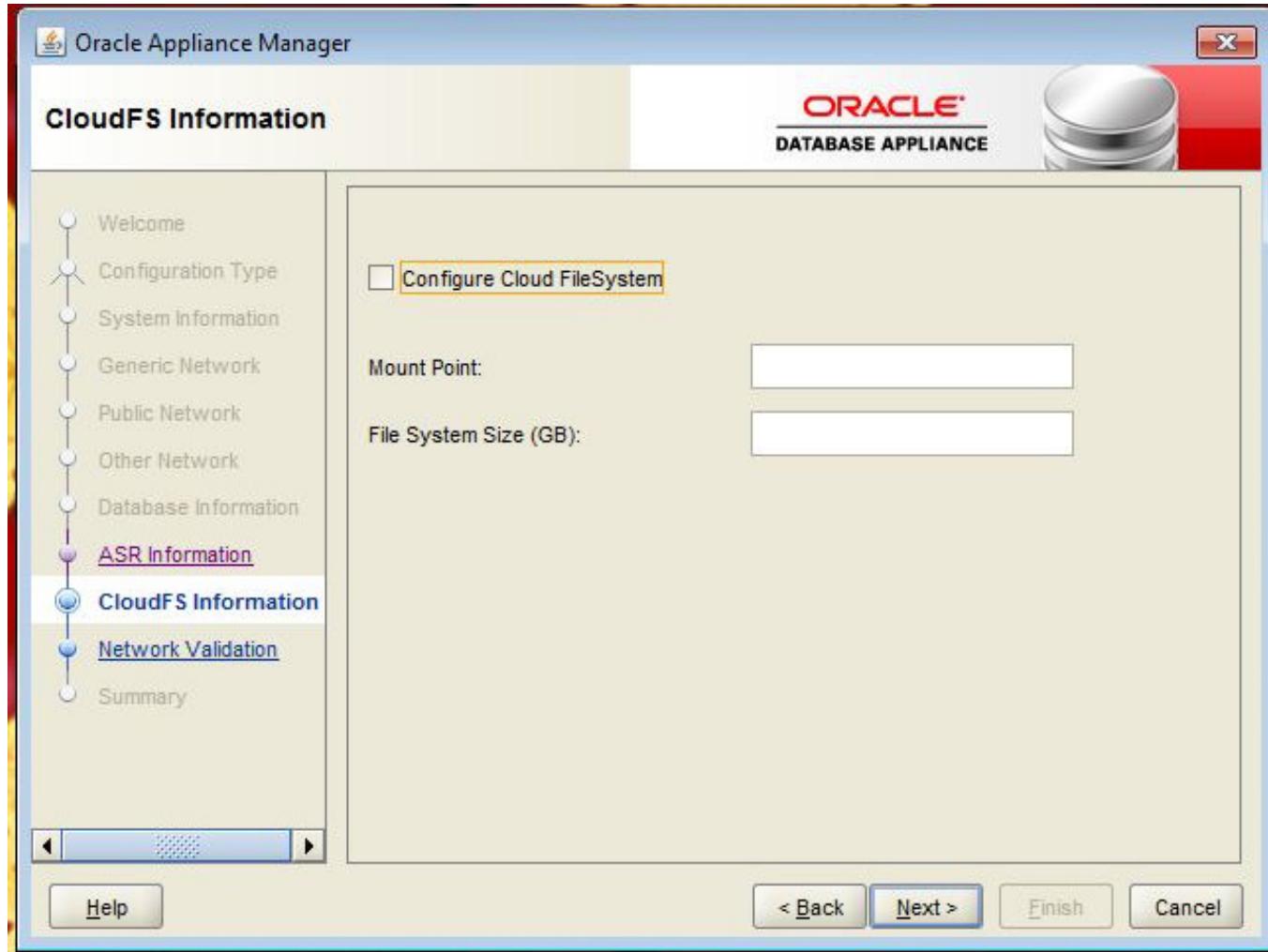
Install Screens: 7



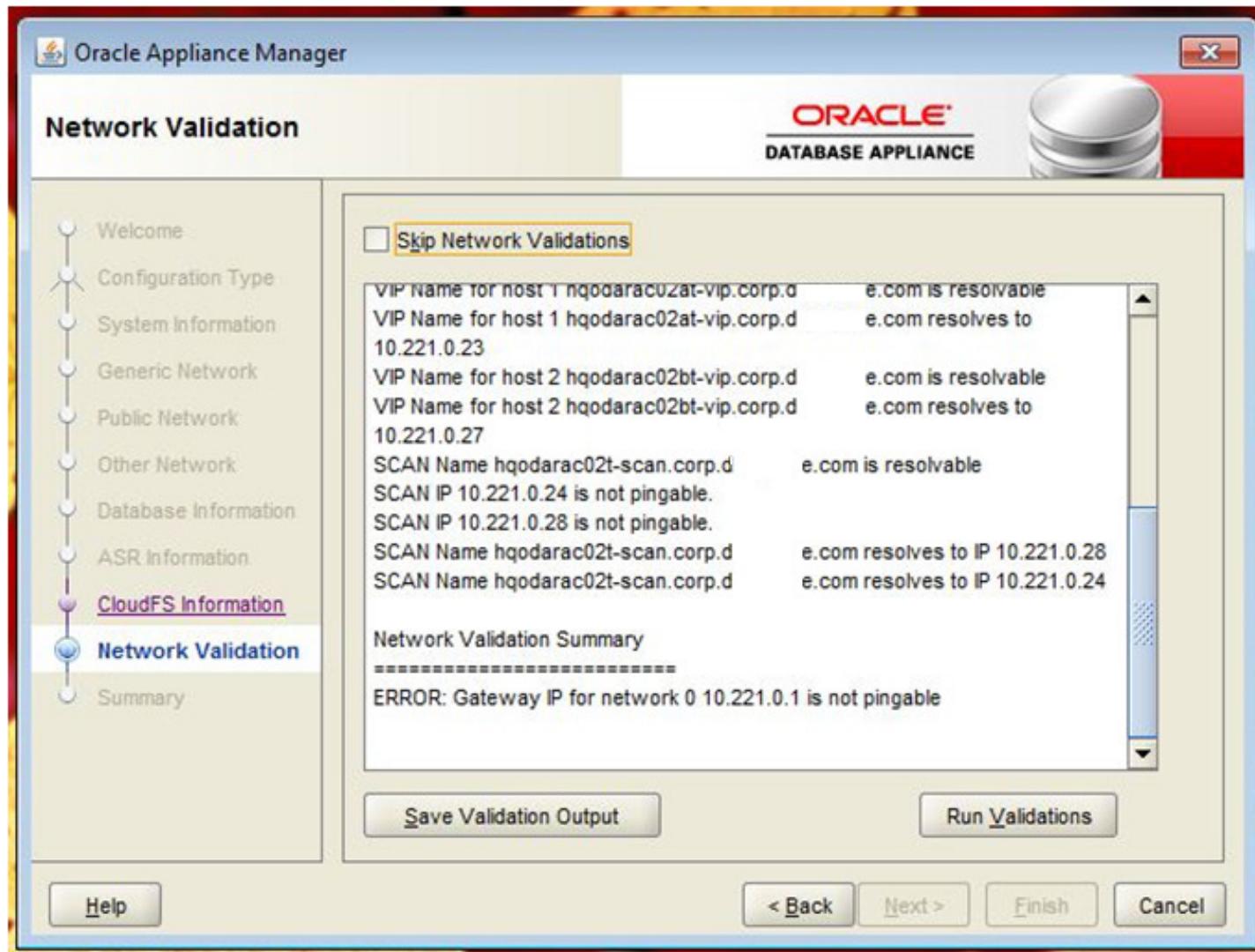
Install Screens: 8



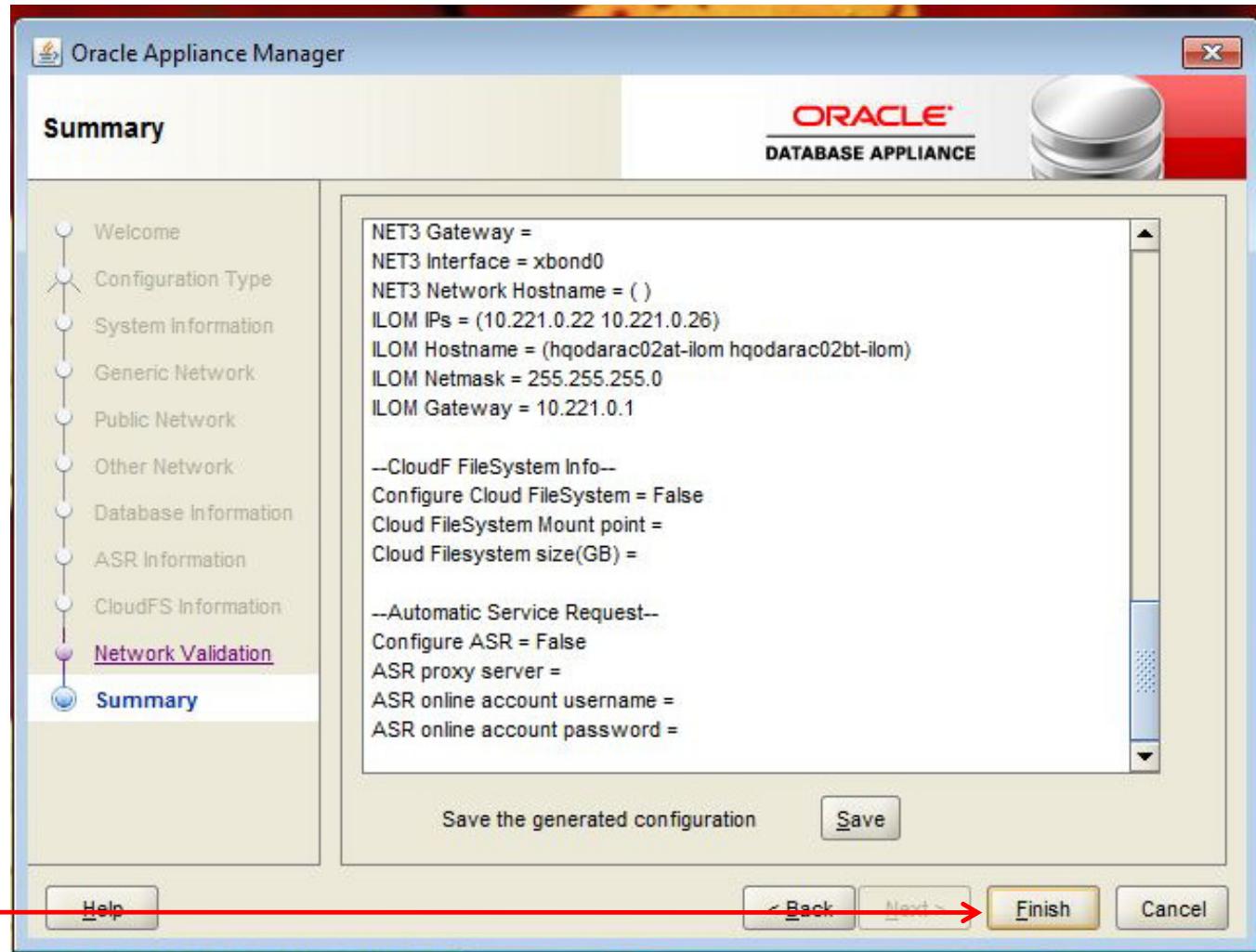
Install Screens: 9



Install Screens: 10



Install Screens: 11





Value Adds

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ILOM: System Information: Overview



Oracle(R) Integrated Lights Out Manager - Windows Internet Explorer
https://192.0.2.101/iPages/suntab.asp Certificate Error Yahoo! Search

Webroot File Edit View Favorites Tools Help

Oracle(R) Integrated Lights Out Manager REFRESH LOG OUT

ABOUT 1 Warning User: root Role: aucro SP Hostname: orclsys2-ilom

Oracle® Integrated Lights Out Manager Java

System Information System Monitoring Power Management Storage Configuration User Management Remote Control Maintenance

Overview Components Fault Management Identification Information Banner Messages Session Timeout Versions

System Overview

View system summary information. You may also change power state and view system status and fault information.

Product Name: SUN FIRE X4370 M2 SERVER

Part/Serial Number: 30102851+1+1 / 1146FMW00R

Host Power: **On** [Change...](#)

System Status: Normal [View...](#)

BIOS Version: 12010304

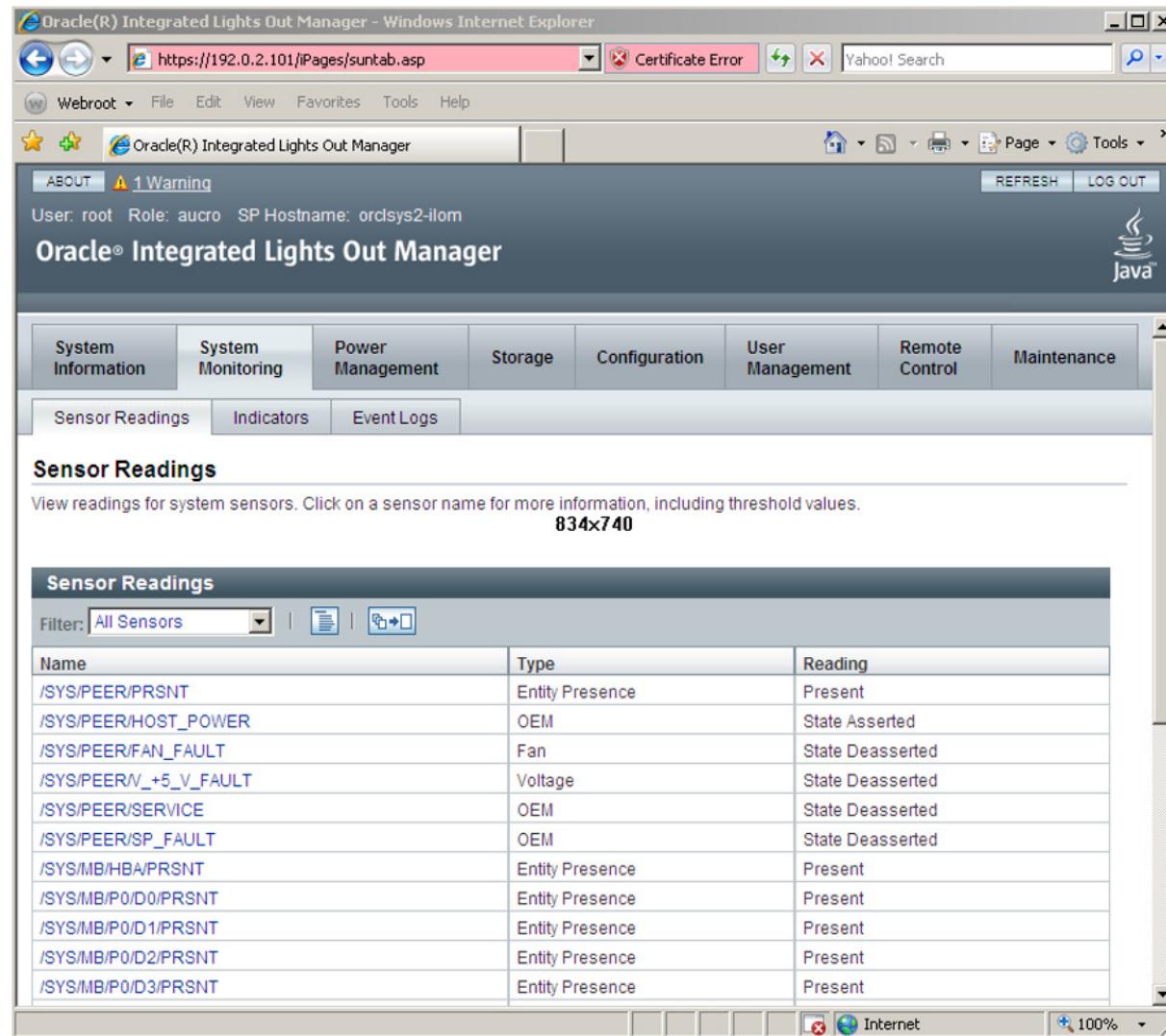
SP Hostname: orclsys2-ilom

Uptime: 0 days, 00:40:38

IP Address: 192.0.2.101

ILOM Version: v3.0.14.13.a r70764

ILOM: System Monitoring: Sensor Readings



The screenshot shows the Oracle Integrated Lights Out Manager (ILOM) interface in a Windows Internet Explorer browser. The title bar reads 'Oracle(R) Integrated Lights Out Manager - Windows Internet Explorer'. The address bar shows the URL 'https://192.0.2.101/iPages/suntab.asp'. A 'Certificate Error' message is displayed in the address bar. The page header includes the 'Webroot' menu, a toolbar with icons for home, search, and print, and a status bar showing 'Page Tools REFRESH LOG OUT'. The main content area displays the 'ABOUT' page with a '1 Warning' message. The user information is 'User: root Role: auco SP Hostname: orclsys2-ilom'. The title 'Oracle® Integrated Lights Out Manager' is centered above a navigation menu with tabs: System Information, System Monitoring (which is selected), Power Management, Storage, Configuration, User Management, Remote Control, and Maintenance. Below the navigation menu is a sub-menu with tabs: Sensor Readings (selected), Indicators, and Event Logs. The main content area is titled 'Sensor Readings' and contains a sub-instruction: 'View readings for system sensors. Click on a sensor name for more information, including threshold values.' A '834x740' dimension indicator is present. The 'Sensor Readings' table has columns: Name, Type, and Reading. The table data is as follows:

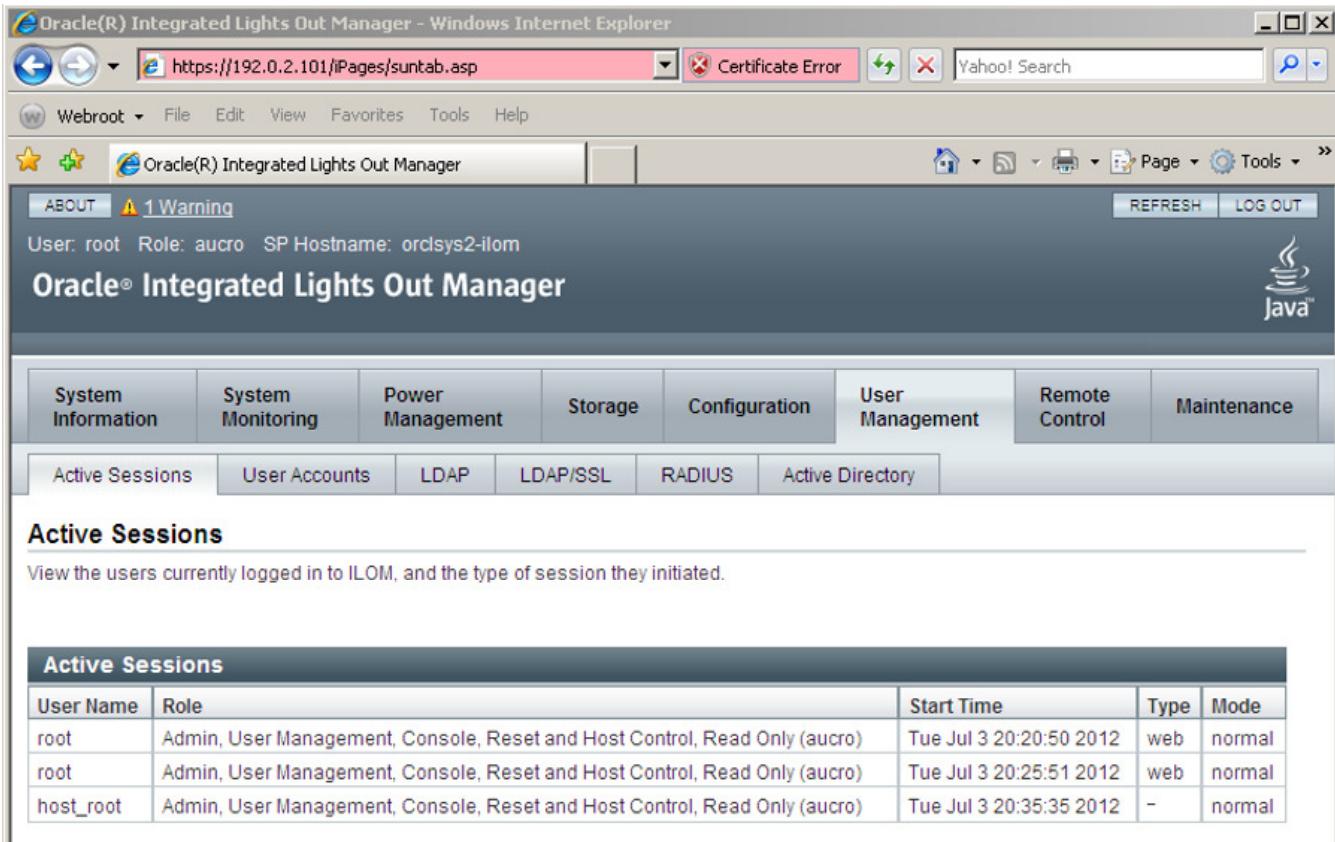
Name	Type	Reading
/SYS/PEER/PRSNTR	Entity Presence	Present
/SYS/PEER/HOST_POWER	OEM	State Asserted
/SYS/PEER/FAN_FAULT	Fan	State Deasserted
/SYS/PEER/V_+5_V_FAULT	Voltage	State Deasserted
/SYS/PEER/SERVICE	OEM	State Deasserted
/SYS/PEER/SP_FAULT	OEM	State Deasserted
/SYS/MB/HBA/PRSNTR	Entity Presence	Present
/SYS/MB/P0/D0/PRSNTR	Entity Presence	Present
/SYS/MB/P0/D1/PRSNTR	Entity Presence	Present
/SYS/MB/P0/D2/PRSNTR	Entity Presence	Present
/SYS/MB/P0/D3/PRSNTR	Entity Presence	Present

ILOM: System Monitoring: Event Logs

A screenshot of a Windows Internet Explorer browser window displaying the Oracle Integrated Lights Out Manager (ILOM) interface. The URL in the address bar is https://192.0.2.101/iPages/suntab.asp. The browser toolbar shows "Certificate Error" and "Yahoo! Search". The main title bar says "Oracle(R) Integrated Lights Out Manager - Windows Internet Explorer". The page title is "Oracle(R) Integrated Lights Out Manager". The top menu bar includes "Webroot", "File", "Edit", "View", "Favorites", "Tools", and "Help". A toolbar with icons for "Home", "Print", "Page", and "Tools" is visible. A banner at the top right shows a Java logo. The main content area has a "System Information" tab selected, with "System Monitoring", "Power Management", "Storage", "Configuration", "User Management", "Remote Control", and "Maintenance" tabs also present. Below these are sub-tabs: "Sensor Readings", "Indicators", and "Event Logs", with "Event Logs" currently selected. A section titled "Event Log" displays a table of event logs. The table has columns: Event ID, Class, Type, Severity, Date/Time, and Description. The data in the table is as follows:

Event ID	Class	Type	Severity	Date/Time	Description
961	Audit	Log	minor	Tue Jul 3 20:42:01 2012	root: Close Session : object = "/SP/session/type" : value = "www" : success
960	Sensor	Log	minor	Tue Jul 3 20:36:36 2012	OEM : /SYS/PEER/HOST_POWER : State Asserted
959	Audit	Log	minor	Tue Jul 3 20:36:11 2012	root: Close Session : object = "/SP/session/type" : value = "www" : success
958	Audit	Log	minor	Tue Jul 3 20:34:17 2012	KCS Command : Clear Message Flags : success
957	Audit	Log	minor	Tue Jul 3 20:34:17 2012	KCS Command : Set BMC Global Enables : enable flags = 0x0 : success
956	IPMI	Log	minor	Tue Jul 3 20:28:50 2012	ID = 206 : 07/03/2012 : 20:28:50 : System Firmware Progress : BIOS : System boot initiated : Asserted
955	IPMI	Log	minor	Tue Jul 3	ID = 205 : 07/03/2012 : 20:28:42 : System Firmware Progress : BIOS : Option ROM

ILOM: User Management: Active Sessions



The screenshot shows the Oracle Integrated Lights Out Manager (ILOM) web interface. The URL in the browser is <https://192.0.2.101/iPages/suntab.asp>. The interface includes a navigation bar with links for System Information, System Monitoring, Power Management, Storage, Configuration, User Management, Remote Control, and Maintenance. The User Management tab is selected, and the Active Sessions sub-tab is active. The main content area displays a table of active sessions:

User Name	Role	Start Time	Type	Mode
root	Admin, User Management, Console, Reset and Host Control, Read Only (aucro)	Tue Jul 3 20:20:50 2012	web	normal
root	Admin, User Management, Console, Reset and Host Control, Read Only (aucro)	Tue Jul 3 20:25:51 2012	web	normal
host_root	Admin, User Management, Console, Reset and Host Control, Read Only (aucro)	Tue Jul 3 20:35:35 2012	-	normal

ILOM: User Management: LDAP / SSL



The screenshot shows the Oracle Integrated Lights Out Manager (ILOM) interface within a Windows Internet Explorer window. The URL is <https://192.0.2.101/iPages/suntab.asp>. The title bar says "Oracle(R) Integrated Lights Out Manager - Windows Internet Explorer". The top menu bar includes "File", "Edit", "View", "Favorites", "Tools", and "Help". The toolbar includes "Home", "Search", "Page", and "Tools". The main header says "Oracle® Integrated Lights Out Manager". The top right corner shows a "Java" logo. The navigation menu at the top has tabs: "System Information", "System Monitoring", "Power Management", "Storage", "Configuration", "User Management" (which is selected), "Remote Control", and "Maintenance". Below the navigation menu is a sub-menu with tabs: "Active Sessions", "User Accounts", "LDAP", "LDAP/SSL" (which is selected), "RADIUS", and "Active Directory". The main content area is titled "LDAP/SSL Management". It contains a configuration section for LDAP/SSL settings, including "Settings", "Certificate Information", "Admin Groups", "Operator Groups", "Custom Groups", "User Domains", and "Alternate Servers". Below this is a "Settings" section with fields for "State" (checkbox "Enabled" checked), "Roles" (dropdown menu "None (server authorization)" with checkboxes for "Admin (a)", "User Management (u)", "Console (c)", "Reset and Host Control (r)", "Read Only (o)", and "Service (s)"), and "Address" (input field "0.0.0.0" with placeholder "IP Address or Hostname"). The bottom of the window shows the Internet Explorer status bar with "100%" and a zoom control.

Remote Control: Host Control: Remote Console



Oracle(R) Integrated Lights Out Manager Remote Console

Redirection Devices Keyboard Video Help

192.0.2.101

```
..No suspend signature on swap, not resuming.
Creating root device.
Mounting root filesystem.

EXT3-fs: INFO: recovery required on readonly filesystem.
EXT3-fs: write access will be enabled during recovery.
...
kjournald starting. Commit interval 5 seconds
EXT3-fs: recovery complete.
EXT3-fs: mounted filesystem with ordered data mode.
Setting up other filesystems.
Setting up new root fs
no fstab.sys, mounting internal defaults
Switching to new root and running init.
unmounting old /dev
unmounting old /proc
unmounting old /sys
SELinux: Disabled at runtime.
SELinux: Unregistering netfilter hooks
.
type=1404 audit(1341398105.123:2): selinux=0 auid=4294967295 ses=4294967295
INIT: version 2.86 booting
        Welcome to Enterprise Linux Server
        Press 'I' to enter interactive startup.
Starting udev
```

ILOM Warning Message



From: **ilom-alert@10.102.2.125** Sent: Thu 9/27/2012 2:50 PM
To: **DSDBA**
Cc:
Subject: dcodarac01bp-ilom:Log:ActDir:critical

(ActDir) _BindAUser: bind error. -1:-1, Can't contact LDAP server. Check cert-file, network connectivity, local date/time

Full Support for High Availability



- RAC
- Data Guard
- RMAN
- Streams
- OEM Cloud Control 12c
 - Diagnostic Pack
 - Tuning Pack
 - Data Masking Pack

One Button Solutions



- Fully scripted, one button, solutions, for
 - Build
 - Secure
 - Migration
 - Bare Metal Restore
 - Data Guard
 - GoldenGate
 - RMAN Backup

Support Center



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Place holder for **STIG** Implementation Script for Oracle Database Appliance

Information Center: Oracle Database Appliance

Information Centers

- Overview
- Hot Topics**
- Resources
- Sun System Handbook
- Hardware Compatibility Lists

Refine Search By Task

- Use Product
- Troubleshoot
- Patching And Maintenance
- Install And Configure
- Upgrade
- Optimize Performance

Information Center: Oracle Database Appliance [ID 1449552.2]

Content Refreshed: 27 Jun 2012

Alerts

View the most up-to-date high impact and urgent issues for your product.?

- ALERT - ODA (Oracle Database Appliance) Mandatory OAK Patch 2.1.0.3.1 [Document 1452085.1 Updated: 04/23/2012]

News & Announcements

Read recently published news and announcements about your product.

No Results

New Troubleshooting and Problem-Solution Documents

Read recently published Troubleshooting and Problem-Solution documents about your product

- NEW ODA SETUP: FAILS WITH DOMAINNAME OF "EXAMPLE", NOT EXAMPLE.COM [Document 1455719.1 Updated: 05/04/2012]
- DBUA (DataBase Upgrade Assistant) failing with "Cannot find the ORACLE_HOME for the database" on ODA (Oracle Database Appliance)

STIG Download



★ Oracle Database Appliance DoD C&A STIG [ID 1456609.1]

To Bottom

Modified: Jul 18, 2012 Type: README Status: PUBLISHED Priority: 3

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[References](#)

Applies to:

Oracle Database Appliance
Generic Linux

Main Content

The Department of Defense(DoD) DISA Information Assurance Process includes Certification and Accreditation(C&A) including the Security Technical Implementation Guides(STIGs). These are guidelines and scripts that are run to advise on securing and locking down database, operating system, application servers, and other system components.

Currently, DoD customers are running various Oracle products that go through the DoD C&A process including the STIG process. General STIG Information is available at: - <http://iase.disa.mil/stigs/>

The Oracle Database Appliance(ODA) is a fully integrated system of software, servers, storage, and networking in a single box that delivers high-availability database services. Oracle engineered Oracle Database Appliance for simplicity. Accordingly, Oracle aims to provide a more simplified configuration and patching process.

STIG Script



■ STIG Script Syntax

- The script logs its actions in the "/opt/oracle/oak/log//hostname/stig/" directory
- **-check** checks the system for guideline violations
- **-force** re-runs the script even if there are no violations
- **-fix** used to implement guideline recommendations
- lock and unlock options 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.

Sample usage

```
# ./stig.sh -fix
```

STIG Script Output: Category 1



```
2012-06-28 01:18:12 : Running stig script version: '1.0'
2012-06-28 01:18:12 : Executing script : ./stig.sh -check
2012-06-28 01:18:12 : Checking for stig violations on system 'orclsys1'
```

2012-06-28 01:18:12 : List of Category-1 stig violation found by script

2012-06-28 01:18:12 : [STIG ID : LNX00140] : [CHECK] : Password for grub not enabled	: FOUND
2012-06-28 01:18:12 : [STIG ID : GEN004640] : [CHECK] : sendmail decode command is not commented in /etc/aliases	: FOUND
2012-06-28 01:18:12 : [STIG ID : LNX00320] : [CHECK] : Privilege account 'shutdown' is present	: FOUND
2012-06-28 01:18:12 : [STIG ID : LNX00320] : [CHECK] : Privilege account 'halt' is present	: FOUND
2012-06-28 01:18:12 : [STIG ID : LNX00580] : [CHECK] : Ctrl-Alt-Del combination to shutdown system is enabled	: FOUND
2012-06-28 01:18:13 : [STIG ID : 2006-T-0013] : [CHECK] : RealVNC rpm is installed on system	: FOUND
2012-06-28 01:18:13 : [STIG ID : LNX00040] : [CHECK] : Support for usb device found in kernel	: FOUND

2012-06-28 01:18:13 : List of Category-2 stig violation found by script

2012-06-28 01:18:13 : [STIG ID : GEN000020] : [CHECK] : Single user mode boot is enabled without a password	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000340] : [CHECK] : Non privileged account oprofile found on system	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000340] : [CHECK] : Non privileged account avahi-autoipd found on system	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000460] : [CHECK] : pam_tally not used to lock account after 3 consecutive failed logins	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000800] : [CHECK] : remember not used in PAM configuration files	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000600] : [CHECK] : Force of at least one lower case character is not set for password	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000600] : [CHECK] : Force of at least one upper case character is not set for password	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000620] : [CHECK] : Force of at least one numeric character is not set for password	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000640] : [CHECK] : Force of at least one special character is not set for password	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000480] : [CHECK] : Login delay is not enabled in /etc/pam.d/system-auth	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000700] : [CHECK] : Maximum age for a password change is more than 60 days	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000540] : [CHECK] : Password can be changed more than once in 24 hours	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000580] : [CHECK] : Password length is less than 8 characters	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN001120] : [CHECK] : Direct login as root is enabled from ssh	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN002100] : [CHECK] : ekshell supported by the pam.rhost	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN002960] : [CHECK] : Access to cron is not through cron.allow and cron.deny	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN003080] : [CHECK] : Permission of file /etc/crontab is more permissive than octal 600	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN003200] : [CHECK] : Permission of file /etc/cron.deny is more permissive than octal 600	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN005400] : [CHECK] : Permission of file /etc/syslog.conf is more permissive than octal 640	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN000920] : [CHECK] : Permission of directory /root is more permissive than octal 700	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN003865] : [CHECK] : tcpdump rpm is installed on system	: FOUND
2012-06-28 01:18:13 : [STIG ID : GEN004000] : [CHECK] : Permission of file /bin/traceroute is more permissive than octal 700	: FOUND
2012-06-28 01:18:13 : [STIG ID : LNX00340] : [CHECK] : Unnecessary account ftp found on system	: FOUND

2012-06-28 01:18:35 : List of Category-3 stig violation found by script

2012-06-28 01:18:35 : [STIG ID : GEN004560] : [CHECK] : sendmail version is not hidden.	: FOUND
---	---------



However

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However



- We MAY want to preserve the 4TB ASM disk for data
- We may want more storage for
 - FRA, Flashback DB files, RMAN files ...
 - Clone
 - Data Masking
 - Real Application Testing
 - Staging
 - Logs
 - And so on

Data Masking Pack



- Offers the ability to mask regulated or confidential data on test and development systems
- Mask format libraries
- Mask definitions
- Masking techniques
 - Condition-based masking
 - Compound masking
 - Deterministic masking
- Application masking templates import or export
- Mask format library import or export
- Masking script generation
- Clone and Mask workflow

Source: Linux Today: 2009

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Choices



- ASM
 - Raw devices
- Clustered Storage
 - Which one? OCFS2, VxFS, ...
- Non-Clustered Storage
 - Non-blocking visibility on both nodes
 - dNFS, CIFS ...

ASM?



- Excellent decision for database storage
- Perhaps not optimal as a file system
 - ACFS?
- Requires raw disk to be presented to ODA
- Traditional HBA discussion

Clustered File System?



- Several CFS available for Linux
 - Need expertise
 - Wire it yourself
 - Tech concerns
 - File sizes
 - File counts
- Still traditional HBA discussion

Non-clustered File System?



- Local File System
 - May be suitable for some applications,
 - But we have two separate hosts in ODA
 - Standard Linux-oriented
 - Still traditional HBA discussion
- [d]NFS
 - Vendor: NetApp, Oracle ZFS Appliance
 - OpenFiler?

Additional concern – silent corruption



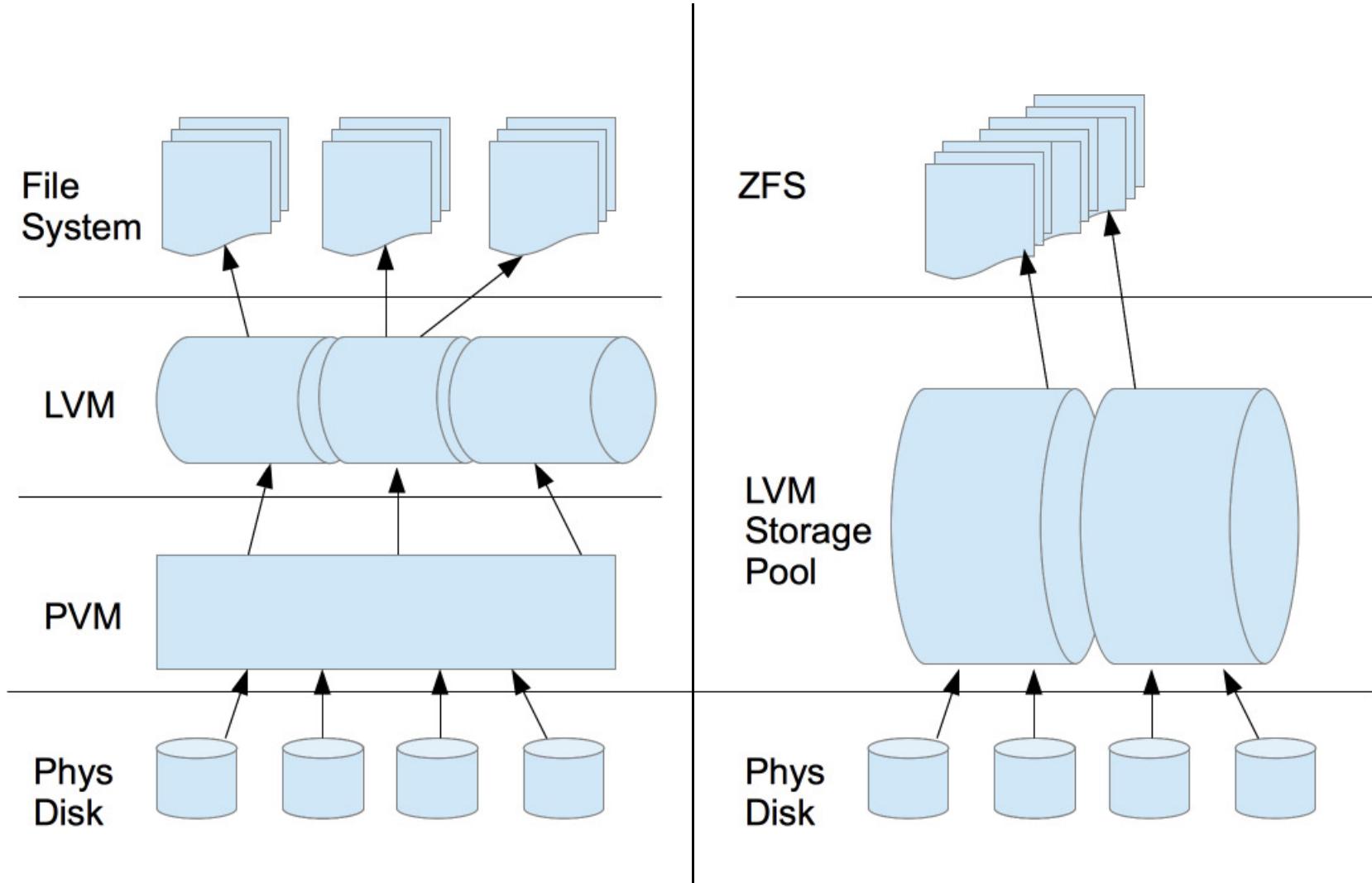
- An undetected or uncorrectable error can occur on average once every 10-20 TB of data storage OR transfer
 - In modern systems that could mean a corruption in as little as 15 minutes
- ZedFS was designed to combat this challenge
 - Checksum on all blocks
 - Copy on Write (preserve original block, not write in place)
 - Hot spares in pool
 - Auto-healing from ZFS mirror
 - Scrub instead of fsck
 - Monthly (or weekly for consumer disks)

Additional concern – silent corruption



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- ZFS was designed to combat this challenge
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 - Auto-healing from ZFS mirror
 - Scrub instead of fsck
 - Monthly (or weekly for consumer disks)

Traditional File System stack vs ZFS



Quick Notes



- RAID
 - ZFS cannot fully protect the user's data when using a hardware RAID controller, as it is not able to perform the automatic self-healing unless it controls the redundancy of the disks and data.
 - Instead, ZFS provides its own RAID counterparts within the Storage Pool
- ZFS provides a hot-spare storage pool manager and a 128-bit, Copy on Write File System
- Capacity
 - Single file: 16 exabytes
 - Files in a pool: 264
 - Disks in a pool: 264
 - Pools in a system: 264

Where do you want to invest your time and treasure?



- Reinventing the wheel?
- Designing physical architecture?
- Applying one-off patches?
- Becoming Linux security experts?
- Writing shell scripts?

or would you rather be ...

- Managing your applications, users, and data?
- Optimizing your applications to maximize customer satisfaction?



ZFS Storage Appliance

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ZFS Storage Appliance

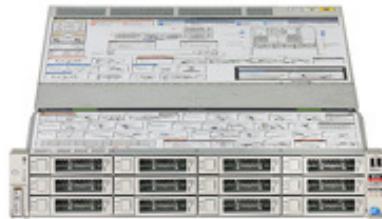


- ZFS file system with advanced error detection and self-healing capabilities
- Integrated with Oracle Engineered Systems
- Both ZFS Deduplication and Compression or Hybrid Columnar Compression
- Hybrid Storage Pools
- Simultaneous multiprotocol support across multiple network interconnects, including GbE, 10 GbE, fibre channel and InfiniBand
- Integrated with OEM Grid Control
- Web-based storage management
- Integrated real-time storage analytics

What is a ZFS Appliance?



- Enterprise class Network Attached Storage (NAS)
- Choose the size that meets your needs
- Hybrid Columnar Compression (w/o an Exadata)
- Hybrid storage pools for DRAM and Flash caches
- DTrace storage analytics
- Use for
 - Backup and Restore
 - Cloning
 - Data Masking



ZFS Configurations



Sun ZFS Storage Appliance Configurations						
	Key Requirement	Maximum Storage Capacity	Space (Rack Units)	Write Optimized Flash	Read Optimized Flash	Cluster Option
Sun ZFS Storage 7120	Low-priced entry-level system with all software features	177 TB	2U/controller, 4U/disk shelf	73 GB	N	N
Sun ZFS Storage 7320	Entry-level cluster option for high availability	432 TB	1U/controller, 4U/disk shelf	Up to 1.2 TB	Up to 2 TB per controller	Y
Sun ZFS Storage 7420	Best price/performance	1.73 PB	3U/controller, 4U/disk shelf	Up to 7.0 TB	Up to 2 TB per controller	Y

ZFS Specifications



Sun ZFS Storage Appliance Specifications			
	Sun ZFS Storage 7120	Sun ZFS Storage 7320	Sun ZFS Storage 7420
Architecture			
Processor	1x 4-core 2.4 GHz Intel® Xeon® Processor	2x 4-core 2.4 GHz Intel® Xeon® Processor, per controller	4x 8-core 2.0 GHz or 10-core 2.4GHz Intel® Xeon® Processors per controller
Main memory	48 GB	Up to 144 GB per controller	Up to 1 TB per controller
Base Configurations			
Configuration options	<ul style="list-style-type: none">• 3.3 TB to 177 TB using either high-speed (15,000 RPM) or high-capacity (7,200 RPM) SAS-2 disks• Controller contains 11 HDDs and one SSD cache, supports up to two additional disk shelves with 24 disks each (300 GB, 600 GB, 2 TB, or 3 TB)	<ul style="list-style-type: none">• 6 TB to 432 TB using either high-speed (15,000 RPM) or high-capacity (7,200 RPM) SAS-2 disks• Supports up to six disk shelves with 20 or 24 disks each (300 GB, 600 GB, 2 TB, or 3 TB) and up to four optional write-optimized SSDs per shelf	<ul style="list-style-type: none">• 6 TB to 1.73 PB using either high-speed (15,000 RPM) or high-capacity (7,200 RPM) SAS-2 disks• Supports up to 24 disk shelves with 20 or 24 disks each (300 GB, 600 GB, 2 TB, or 3 TB) and up to four optional write-optimized SSDs per shelf

ZFS In The Data Center



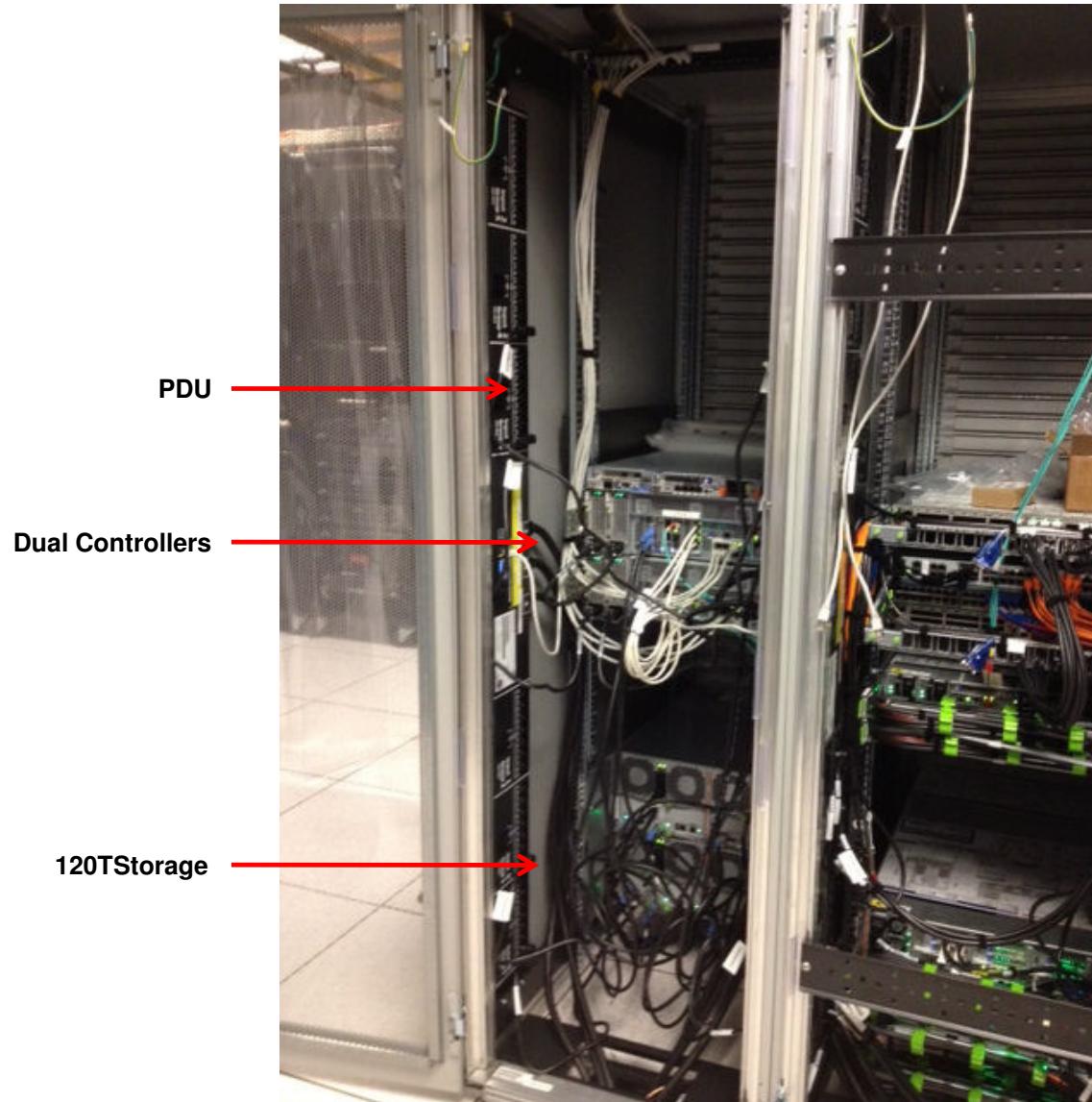
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ZFS 7420



ZFS Internals



ZFS BUI: Config Services



SUN ZFS STORAGE 7420 ! The cluster peer has rejoined the cluster.

LOGOUT HELP Dismiss

Configuration Maintenance Shares Status Analytics

SERVICES STORAGE NETWORK SAN CLUSTER USERS PREFERENCES ALERTS

Services

Data Services					
●	NFS	Online	2012-10-10 09:28:04		
●	iSCSI	Disabled	2012-9-25 16:19:00		
●	SMB	Disabled	2012-9-25 16:19:15		
●	FTP	Disabled	2012-9-20 17:49:03		
●	HTTP	Disabled	2012-9-20 17:49:03		
●	NDMP	Disabled	2012-9-25 16:19:21		
●	Remote Replication	Online	2012-9-20 17:49:50		
●	Shadow Migration	Online	2012-9-20 17:49:50		
●	SFTP	Online	2012-9-21 18:50:18		
●	SRP	Disabled	2012-9-20 17:49:03		
●	TFTP	Disabled	2012-9-20 17:49:54		
●	Virus Scan	Disabled	2012-9-29 17:49:03		

Directory Services					
●	NIS	Disabled	2012-9-25 16:12:36		
●	LDAP	Online	2012-9-25 16:12:36		
●	Active Directory	Online	2012-9-25 15:59:30		
●	Identity Mapping	Online	2012-9-25 15:56:16		

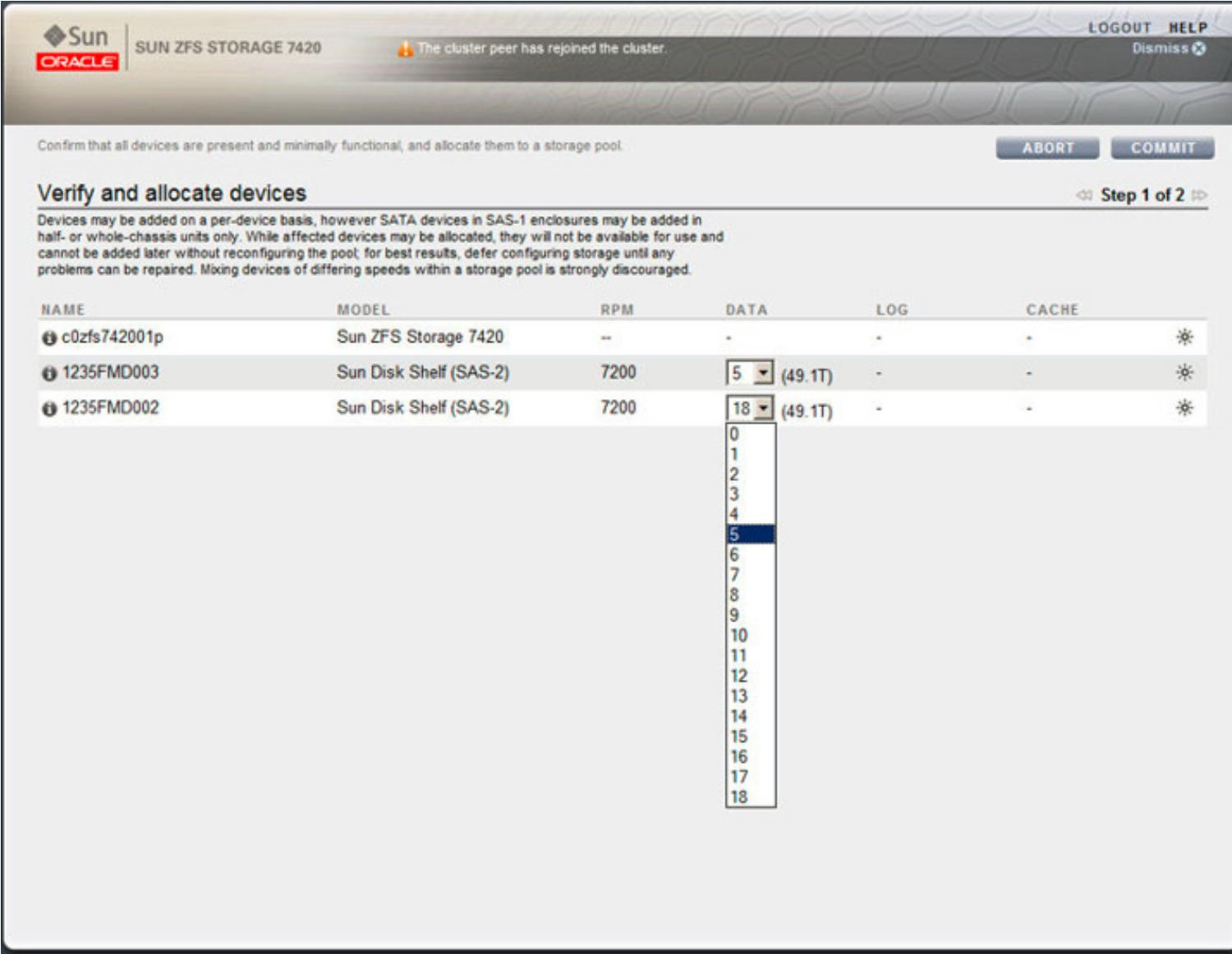
System Settings					
●	DNS	Online	2012-9-25 16:12:36		
●	IPMP	Online	2012-9-20 17:49:51		
●	NTP	Online	2012-9-24 14:23:46		
●	Phone Home	Disabled	2012-9-20 17:49:50		
●	Dynamic Routing	Online	2012-10-8 14:53:10		
●	Service Tags	Online	2012-9-20 17:49:50		
●	SMTP	Online	2012-9-25 16:12:36		
●	SNMP	Online	2012-9-21 18:39:52		
●	Syslog	Online	2012-9-21 18:20:47		
●	System Identity	Online	2012-9-20 17:52:32		

Remote Access					
●	SSH	Online	2012-9-20 17:52:33		

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ZFS BUI: Config Storage



The screenshot shows the Sun ZFS Storage 7420 BUI interface. At the top, there is a message: "The cluster peer has rejoined the cluster." On the right, there are "LOGOUT", "HELP", and "Dismiss" buttons. Below the message, a confirmation message reads: "Confirm that all devices are present and minimally functional, and allocate them to a storage pool." There are "ABORT" and "COMMIT" buttons on the right. The main area is titled "Verify and allocate devices" and includes a note: "Devices may be added on a per-device basis, however SATA devices in SAS-1 enclosures may be added in half- or whole-chassis units only. While affected devices may be allocated, they will not be available for use and cannot be added later without reconfiguring the pool; for best results, defer configuring storage until any problems can be repaired. Mixing devices of differing speeds within a storage pool is strongly discouraged." A table lists three devices: "c0zfs742001p" (Sun ZFS Storage 7420), "1235FMD003" (Sun Disk Shelf (SAS-2)), and "1235FMD002" (Sun Disk Shelf (SAS-2)). The "1235FMD002" row has a dropdown menu open for selecting a pool, with the number "5" selected. The table columns are: NAME, MODEL, RPM, DATA, LOG, and CACHE.

NAME	MODEL	RPM	DATA	LOG	CACHE
c0zfs742001p	Sun ZFS Storage 7420	--	-	-	*
1235FMD003	Sun Disk Shelf (SAS-2)	7200	5 (49.1T)	-	*
1235FMD002	Sun Disk Shelf (SAS-2)	7200	18 (49.1T)	-	*

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ZFS BUI: Config Storage



SUN ZFS STORAGE 7420 | **The cluster peer has rejoined the cluster.** | LOGOUT HELP | Dismiss X

Confirm that all devices are present and minimally functional, and allocate them to a storage pool. | ABORT | COMMIT | Step 2 of 2

Choose Storage Profile

Configure available storage into a pool by defining its underlying redundancy profile. Carefully read the profile descriptions to understand how each balances the inherent trade-offs between availability, performance, and capacity, and select the profile that best fits your workload. If available, NSPF indicates no single point of failure, which affords certain profiles the ability for a pool to survive through loss of a single disk shelf.

Storage Breakdown		Data Profile					
Type	Size	Type	NSPF	Availability	Performance	Capacity	Size
Data	18.8T	Double parity	No	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	18.8T
Parity	5.46T	Mirrored	Yes	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	10.7T
Reserved	308G	Mirrored	No	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	10.7T
Spare	2.73T	Single parity, narrow stripes	No	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	16.1T
		Striped	No	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	26.9T
		Triple mirrored	Yes	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	8.06T
		Triple mirrored	No	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	8.06T
		Triple parity, wide stripes	No	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	<div style="width: 100px; height: 10px; background-color: #ccc; border: 1px solid #ccc; display: inline-block;"></div>	16.1T

Disk Breakdown

Data + Parity	9 disks
Spare	1 disks
Log	0 disks
Cache	0 disks

Data profile: Double parity

Each array stripe contains two parity disks, yielding high availability while increasing capacity over mirrored configurations. Double parity striping is recommended for workloads requiring little or no random access, such as backup/restore.

ZFS BUI: Config Network Config



SUN ZFS STORAGE 7420

Super-User@c0zfs742001p LOGOUT HELP

Configuration Maintenance Shares Status Analytics

Configuration Addresses Routing

REVERT APPLY

Network

To configure networking, build Datalinks on Devices, and Interfaces on Datalinks. Click on a pencil icon to edit object properties. Select an object to view its relationship to other objects. Drag objects to extend Aggregations or IP Multipathing Groups.

Devices 12 total

BUILT-IN

- igb0 1Gb (full)
- igb1 1Gb (full)
- igb2 link down
- igb3 link down

PCIe 3

- ixgbe0 10Gb (full)
- ixgbe1 link down

PCIe 6

- ixgbe2 10Gb (full)
- ixgbe3 link down

PCIe 7

- ibp2 port down
- ibp3 port down

PCIe 2

- ibp0 port down
- ibp1 port down

Datalinks 4 total

- ↔ igb0 via igb0
- ↔ igb1 via igb1
- ↔ ixgbe0 Custom MTU(9000), via ixgbe0
- ↔ ixgbe2 Custom MTU(9000), via ixgbe2

Interfaces 4 total

- head1 net0 IPv4 static, 192.168.40.248/22, via igb0
- head2 net1 IPv4 static, 192.168.40.249/22, via igb1
- private10gb private10gb IPv4 static, 10.221.112.49/24, via ixgbe0
- private10gb2 private10gb2 IPv4 static, 10.221.112.50/24, via ixgbe2

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ZFS BUI: Configuration Services LDAP



The screenshot shows the Sun ZFS Storage 7420 Configuration Services LDAP interface. The top navigation bar includes links for Configuration, Maintenance, Shares, Status, and Analytics. The Configuration tab is selected, and the Services sub-tab is also selected. The LDAP tab is active, indicated by a green dot. The main content area displays the LDAP Directory Service configuration. It includes a description of the service, a status bar showing "2012-10-11 12:30:32 Online", and configuration options for SSL/TLS protection, base search DN (dc-unix, dc-m1ib, dc=com), search scope (Subtree selected), authentication method (Simple (RFC 4513)), bind credential level (Anonymous selected), and a schema definition section. Below this is a table for managing servers, showing one entry for "perrito3.m1ib.com:389".

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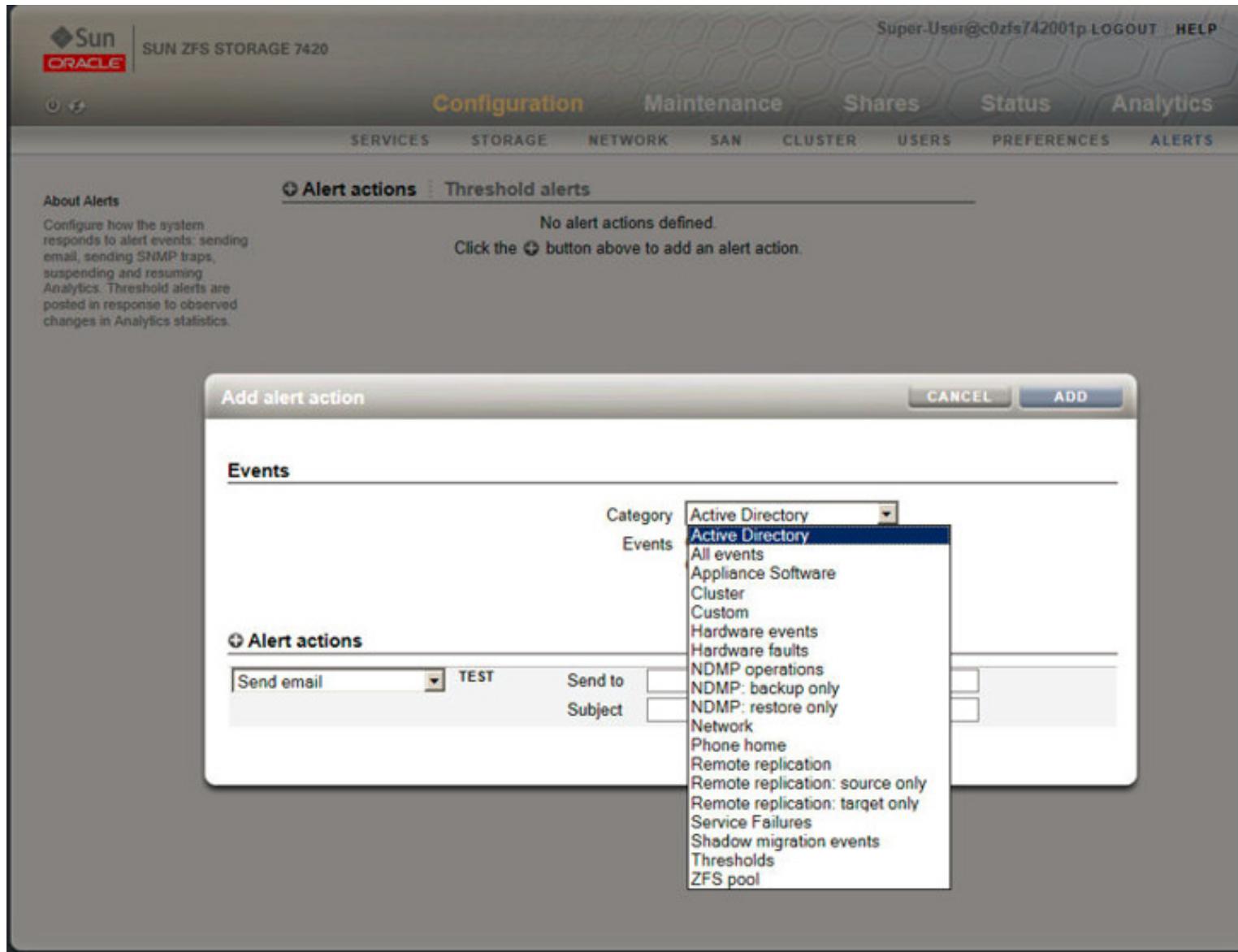
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ZFS BUI: Maintenance Logs



		Configuration	Maintenance	Shares	Status	Analytics	
			Hardware	System	Problems	Logs	Workflows
Alerts	119 Total						
ALERTS	FAULTS	SYSTEM	AUDIT	PHONE	HOME		
TIME	EVENT ID	DESCRIPTION				TYPE	
2012-9-24 15:29:46	63714813-695f-c125-f88e-e434ebcd27d	The system has finished scrubbing the ZFS pool 'GENERIC'.				Minor Alert	
2012-9-24 15:29:46	a6838d57-8ee4-43d2-e42f-c695e62ccb0e	The system has begun scrubbing the ZFS pool 'GENERIC'.				Minor Alert	
2012-9-24 15:14:54	4ada53dd-7124-cfc6-dbd1-c279f717d381	The system has finished scrubbing the ZFS pool 'RMANBACK'.				Minor Alert	
2012-9-24 15:14:53	8e22aee9-a6b4-4c79-cbf9-f61bb1b5fe8d	The system has begun scrubbing the ZFS pool 'RMANBACK'.				Minor Alert	
2012-9-24 14:23:44	2d5106de-ee58-c299-c247-8882df53ffb7	Network connectivity via datalink ixgbe0 has been established.				Minor alert	
2012-9-24 14:23:44	0a2e7265-49bf-cb50-e280-d1812ff449d1	Full IP connectivity via interface ixgbe0 has been established.				Minor alert	
2012-9-24 14:23:44	cd81ccf9-8ee1-eb79-f46e-9e86513c2ad3	Network connectivity via port ixgbe0 has been established.				Minor alert	
2012-9-24 14:23:30	985892eb-6a10-653d-c73a-d901f91f5443	Network connectivity via datalink ixgbe0 has been lost.				Major alert	
2012-9-24 14:23:30	0d81abd7-c431-e3b4-835f-cfcc01170dac	IP connectivity via interface ixgbe0 has been lost due to link-based failure.				Major alert	
2012-9-24 14:23:30	b979b7b9-9129-e2d5-ae44-b5bc6bc3c1ae	Network connectivity via port ixgbe0 has been lost.				Minor alert	
2012-9-24 14:23:16	78d4a9b8-5664-44a9-af07-d8eab505b33a	Full IP connectivity via interface ixgbe2 has been established.				Minor alert	
2012-9-24 14:23:15	d8a0d18b-346c-665e-c9af-acef6acdd23c	Network connectivity via datalink ixgbe2 has been established.				Minor alert	
2012-9-24 14:23:15	b55569fb-330b-496a-a619-cd30001473de	Network connectivity via port ixgbe2 has been established.				Minor alert	
2012-9-24 14:23:10	9022ff22-7be1-e65c-f929-da96173fa21f	IP connectivity via interface ixgbe2 has been lost due to link-based failure.				Major alert	
2012-9-24 14:23:10	d70af351-ca2a-cb6d-8a54-b6e9f1366c8b	Network connectivity via datalink ixgbe2 has been lost.				Major alert	
2012-9-24 14:23:10	01c8f48b-06a9-c95c-d560-e0e98a944f39	Full IP connectivity via interface ixgbe2 has been established.				Minor alert	
2012-9-24 14:23:10	2246e904-22ad-4a40-ca2c-d5f5b2d357ec	Network connectivity via port ixgbe2 has been lost.				Minor alert	
2012-9-24 14:23:10	ddcc68fb-eaef-4b7f-83a4-9ca3e75d0543	Network connectivity via datalink ixgbe2 has been established.				Minor alert	
2012-9-24 14:23:10	de514e43-5839-6b56-92a3-e31a44caeb06	Network connectivity via port ixgbe2 has been established.				Minor alert	
2012-9-24 14:23:10	68f550f6-d4f2-c76e-ea2b-babf8d03c455	IP connectivity via interface ixgbe2 has been lost due to link-based failure.				Major alert	

ZFS BUI: Configuration Alerts

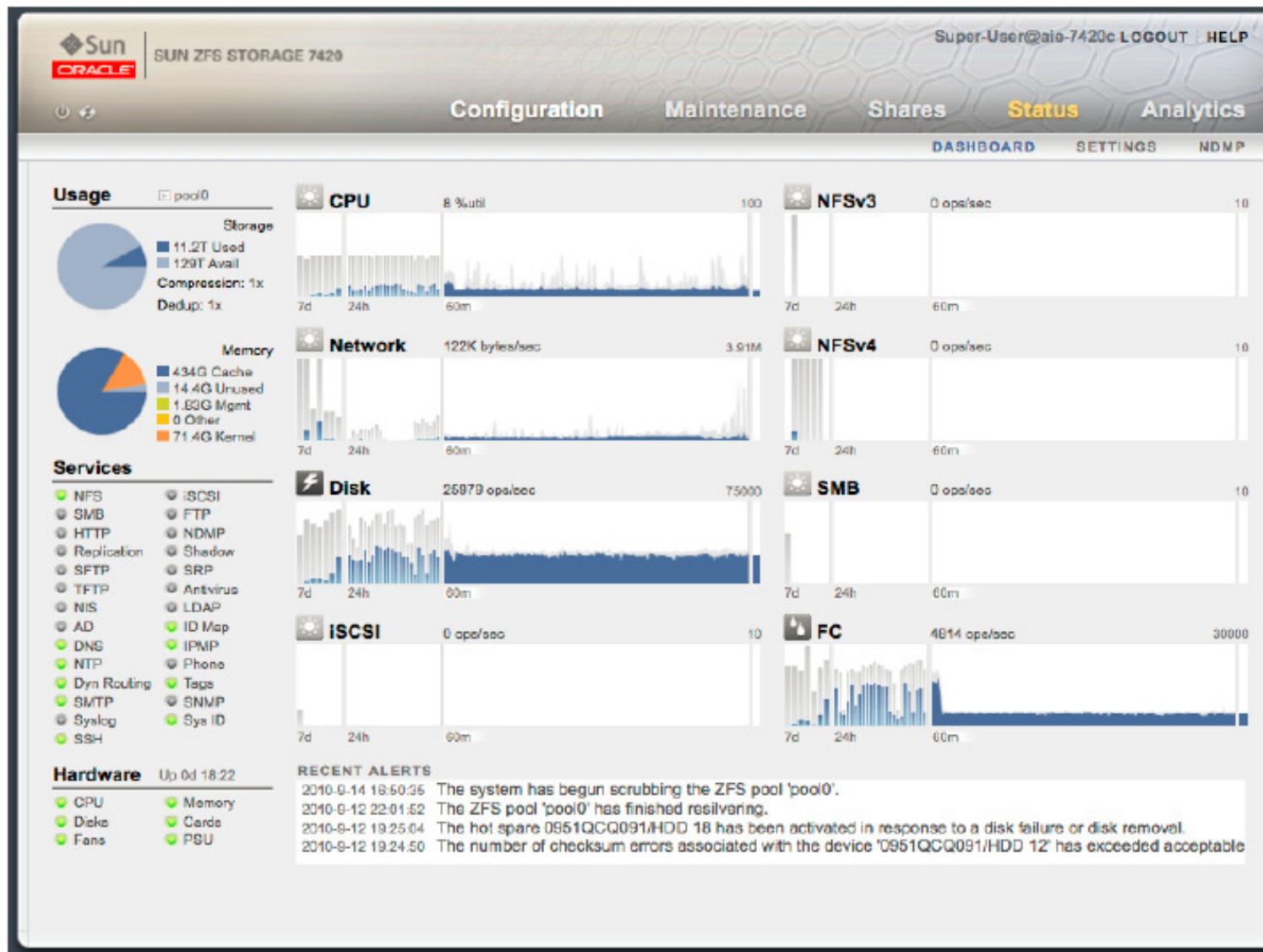


The screenshot shows the Sun ZFS Storage 7420 BUI interface. The top navigation bar includes the Sun logo, 'SUN ZFS STORAGE 7420', 'Super-User@c0zfs742001p LOGOUT HELP', and tabs for Configuration, Maintenance, Shares, Status, Analytics, Services, Storage, Network, SAN, Cluster, Users, Preferences, and Alerts. The 'Alert actions' tab is selected under the Configuration tab. A sub-section titled 'Threshold alerts' is shown with the message 'No alert actions defined.' and a note to 'Click the + button above to add an alert action.' A modal dialog box titled 'Add alert action' is open, showing the 'Events' section. It includes a 'Category' dropdown set to 'Active Directory' (with 'Active Directory' selected), an 'Events' dropdown showing various event types, and an 'Alert actions' section with a 'Send email' dropdown set to 'TEST', 'Send to' and 'Subject' fields, and a 'TEST' button.

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Integrating Oracle Database Appliance with Sun ZFS Appliance to Achieve HA Security Presented: Ottawa Oracle User Group - 20 November, 2012

ZFS Storage Appliances



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How Does This Change Our Jobs?



Job Title	Loses	Gains
Storage Admins	Time wasted monitoring competing loads on the storage appliance balancing competing need to read/write cache, and allocation of disk.	More efficient storage environment as it is all file system.
Network Admins	Pain and suffering	Time to devote to troubleshooting, security monitoring, and other value-added tasks.
System Admins	<ul style="list-style-type: none">Gives up appliance root passwordGives up 2:00am support calls	
Database Admins		Patching operating system, firmware, and database as a single unit with patches previously tested for compatibility

Your ODA is not a general purpose computer, will not be hosting files, applications, middleware, etc.

How Does This Change Our Jobs?



- Storage Admin
 - No longer required
- Network Admin
 - Only required for public network interface
- System Admin
 - Advise on configuration
 - Install backup agent (ie Networker)
 - Install security software (ie TripWire)
- DBA
 - Just like with ASM ... assumes broader responsibility for deployment and patching
 - Gives up large amounts of unproductive time debugging configurations

Questions



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



Thank you