Oracle11g R2 Clusterware: Architecture and Best Practices of Configuration and Troubleshooting

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About Author

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  - IOUG Virtualization SIG Board Member
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  - Oracle Blog: http://kyuoracleblog.wordpress.com/

- Dell Oracle Solutions Engineering: www.dell.com/oracle
  - Oracle Technology Solutions on Dell systems/storages
  - Dell | Oracle Solutions Components
  - Solutions stack: servers, storage, network, OS, virtualization, Oracle RAC, Oracle Applications

Our Engineering Lab

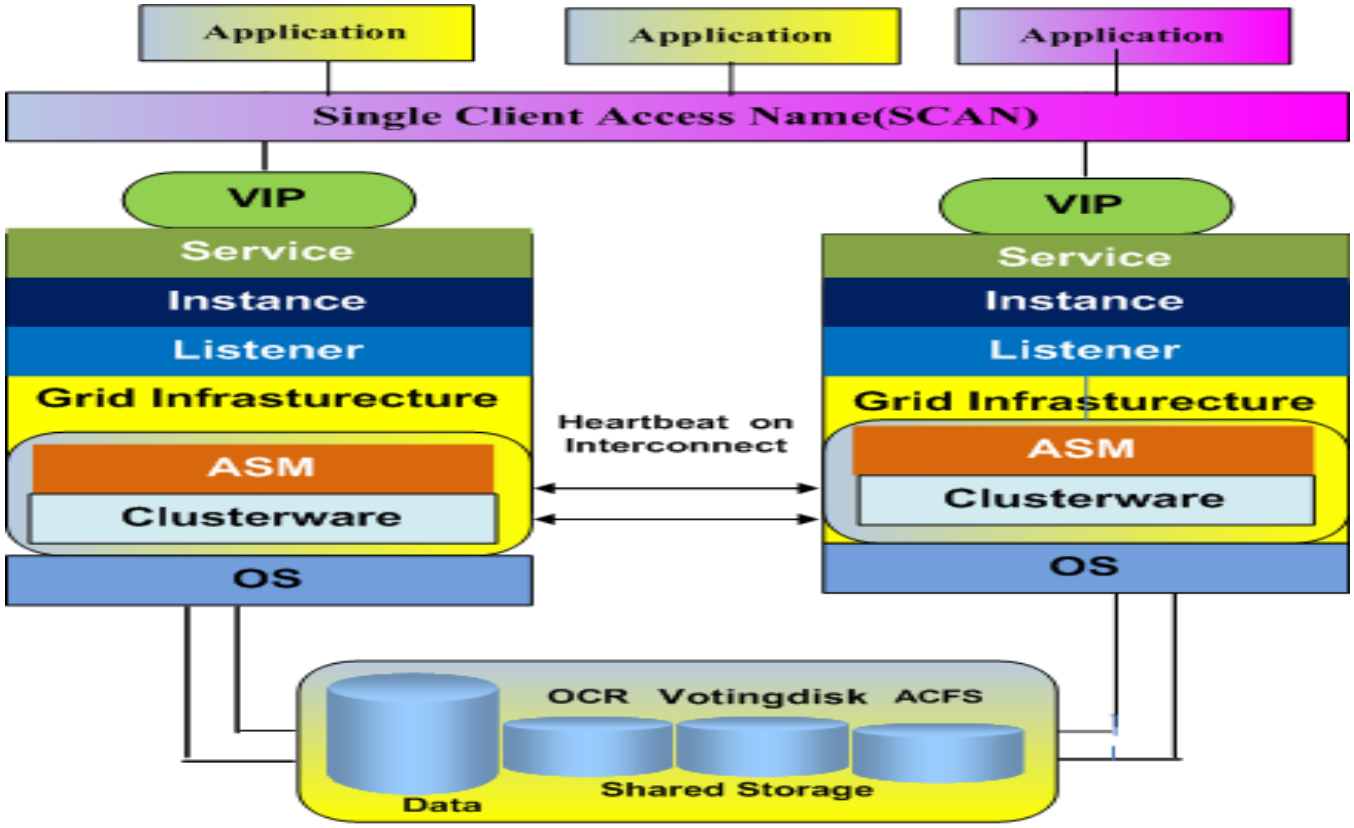
Agenda

- Oracle 11g R2 Clusterware Architecture
- Storage Configuration
- Network Configuration
- Managing Oracle Clusterware
- Clusterware Troubleshooting
- QA

Oracle Clusterware Architecture

Oracle Clusterware Architecture

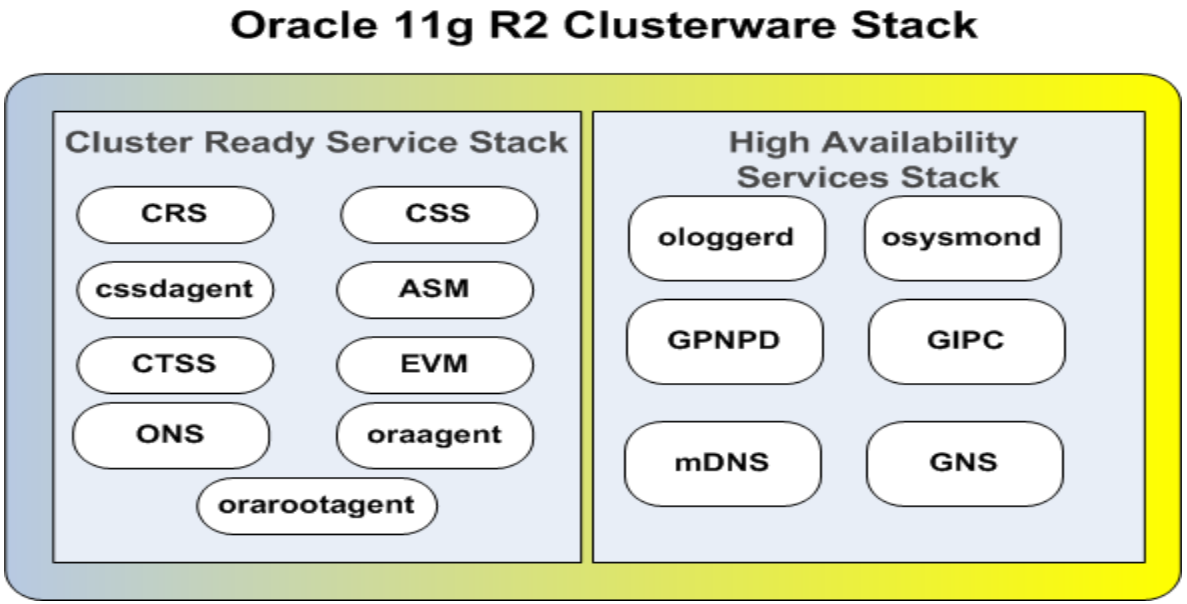
- Oracle Clusterware:
  - Role: Provide the base infrastructure to run RAC
  - Allow cluster nodes to communicate each other



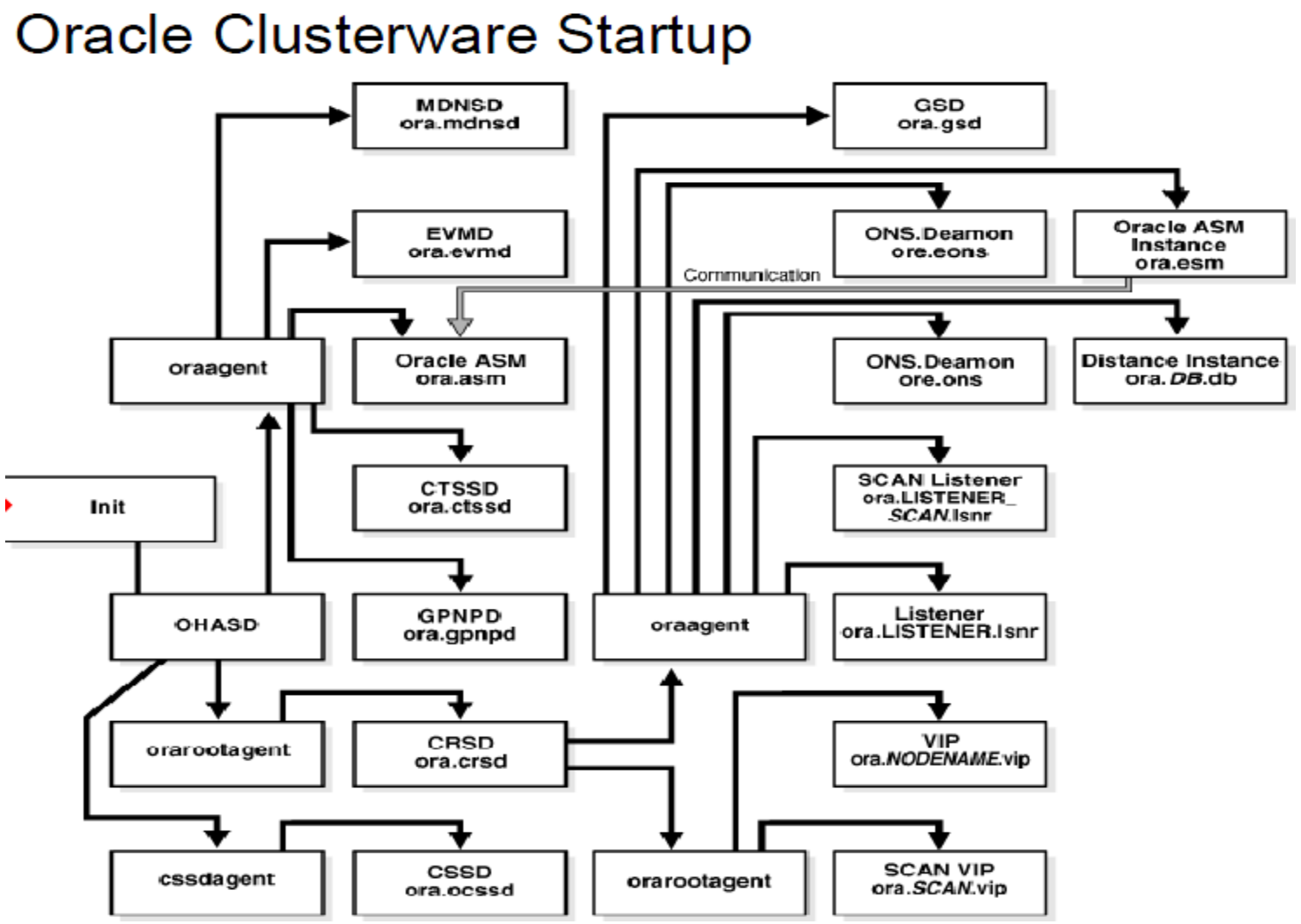
11g R2 Clusterware and RAC

Oracle Clusterware Architecture

- Grid Infrastructure: Clusterware + ASM
  - Two products installed in the same $GI_ORACLE_HOME
- Oracle clusterware components running on each node
  - Voting disk: stores cluster membership used by CSS
  - OCR stores information about clusterware resources
    multiplexed OCR for high availability used by CRS
  - OLR(Oracle Local Registry): $GI_HOME/cdata/<host>.olr
  - Oracle Clusterware Stacks

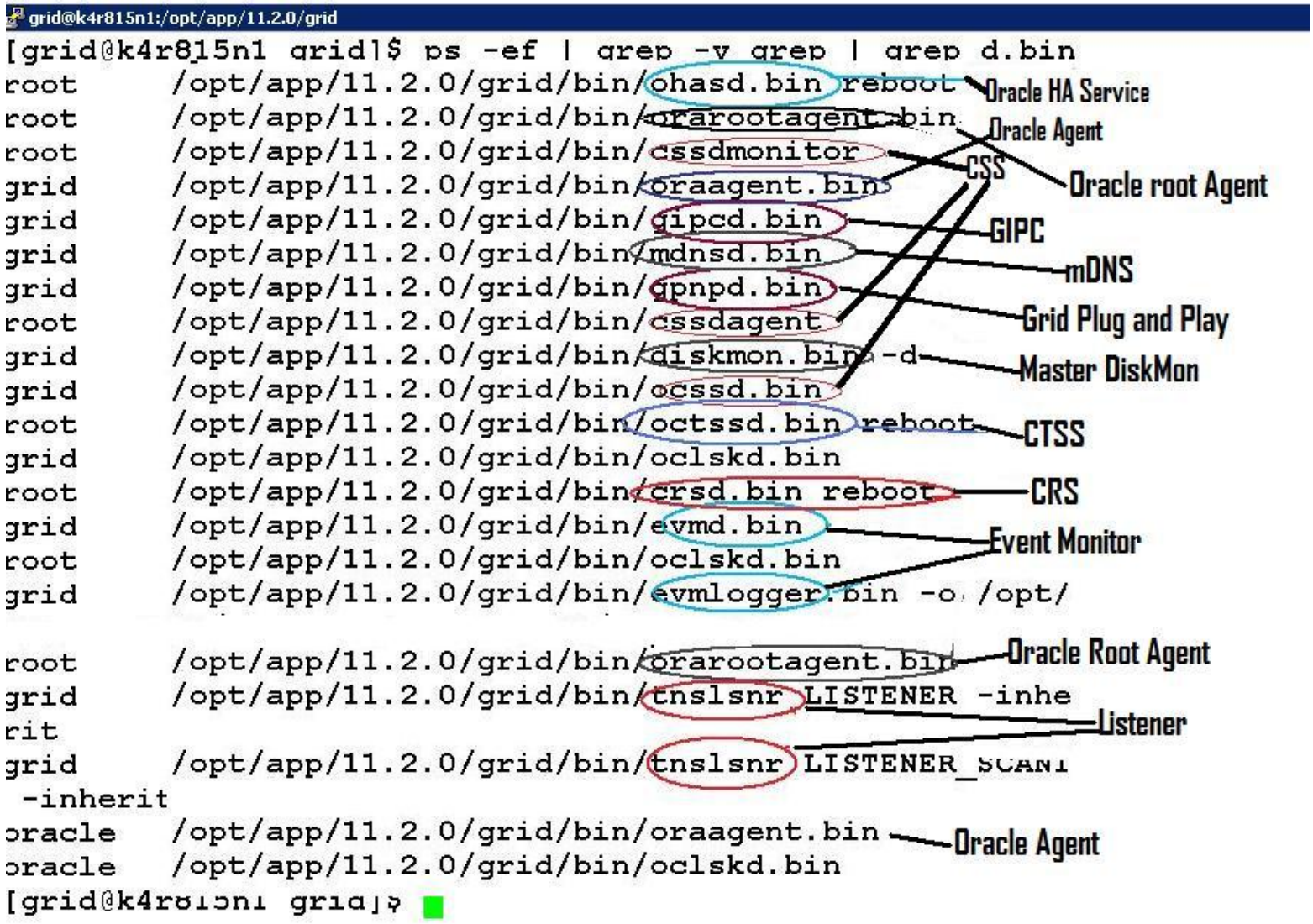


Oracle Clusterware Architecture



**Markus Michalewicz: Oracle Clusterware 11g Release 2– A First Glimpse Under the Hood*

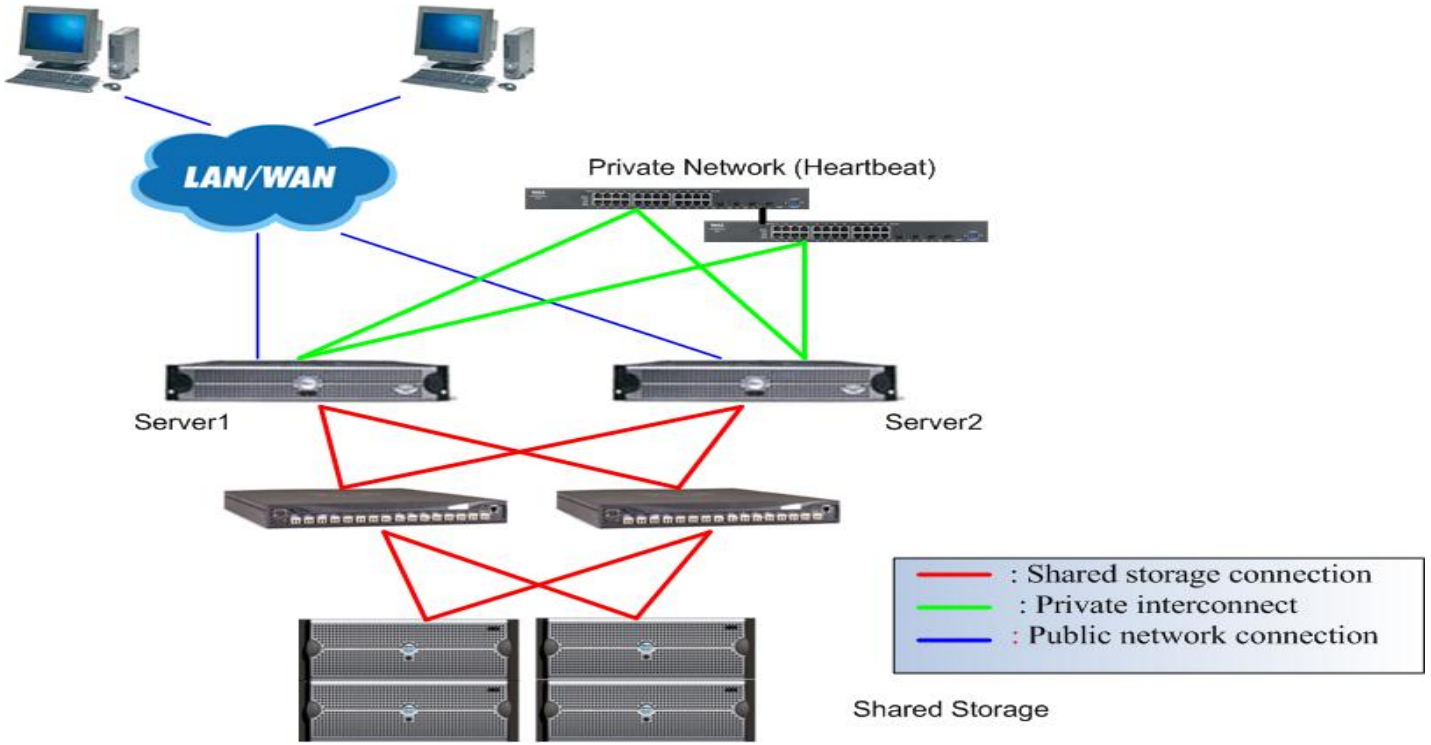
Oracle Clusterware Architecture



Storage Configuration

Shared Storage Configuration

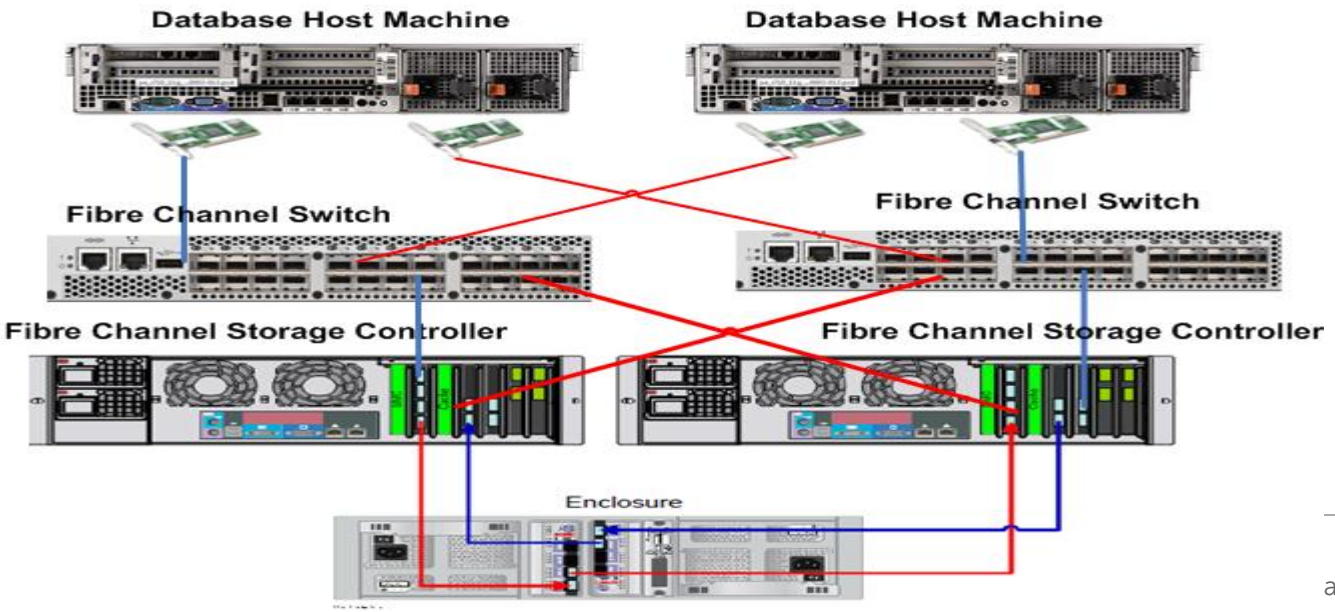
- Hardware Configuration of Oracle Clusterware
  - Servers, shared storage, interconnect
  - Two interconnect switches for redundant interconnects
  - Butterfly connections to shared storage:
    Servers <-> IO Switches <->SAN storage



Shared Storage Configuration

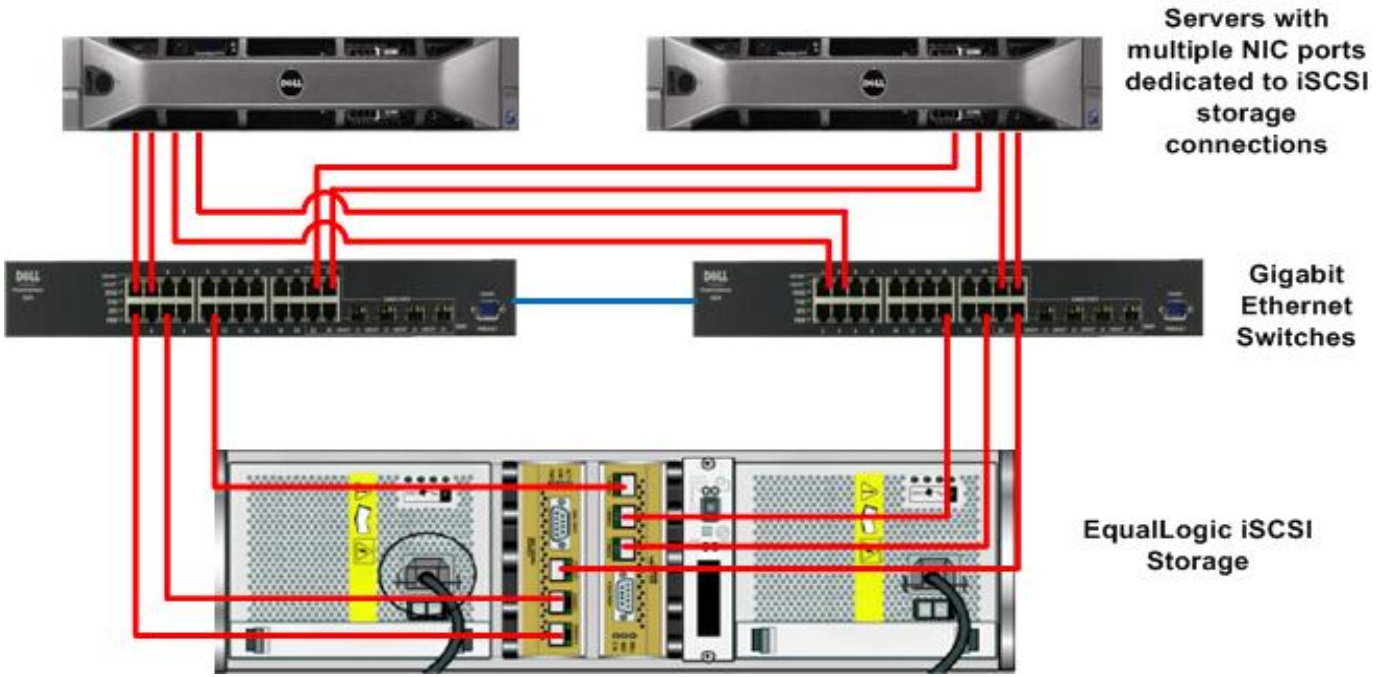
- Shared Storage Requirement:
  - Shared storage for OCR and voting disk
  - Types: block devices, RAW devices, OCFS/OCFS2, NFS on certified NAS (Oracle Storage Compatibility Program list)
  - HA requirement for the shared storage
- Physical connections to shared SAN storage
  - Fully Redundant active-active IO paths: for HA and IO Load balancing

FC storage: dual HBAs and dual FC switches: each server has two independent paths to both storage processors



Shared Storage Configuration

For iSCSI storage:
Fully redundant IO paths for iSCSI storage, multiple NIC card each server; two Gigabit Ethernet switches. On each storage control module, one network interface connects to one switch and other two network interfaces connects to other switch



Shared Storage Configuration

- Multipath Devices of the Shared Storage
  - Multipathing device driver to combine multiple IO paths
  - Example of configuring Linux Device Mapper (DM)
  - Verify : rpm –qa | grep device-mapper
  - Find the unique SCSI ID of the device:

    $/sbin/scsi_id -gus /block/sdb

    36090a028e093fc906099540639aa2149

    $/sbin/scsi_id -gus /block/sde

    36090a028e093fc90609954063g9aa2149
  - Configure multipathing in /etc/multipath.conf

```
multipath {
 wwid   36090a028e093fc906099540639aa2149  #<---- for sdb  and sde
        alias  votingdisk1
}
```

  - service multipathd restart

    multipath -ll

    *ls -lt /dev/mapper/**

    brw-rw---- 1 root disk 253, 8 Feb 18 02:02 /dev/mapper/votingdisk1

Shared Storage Configuration

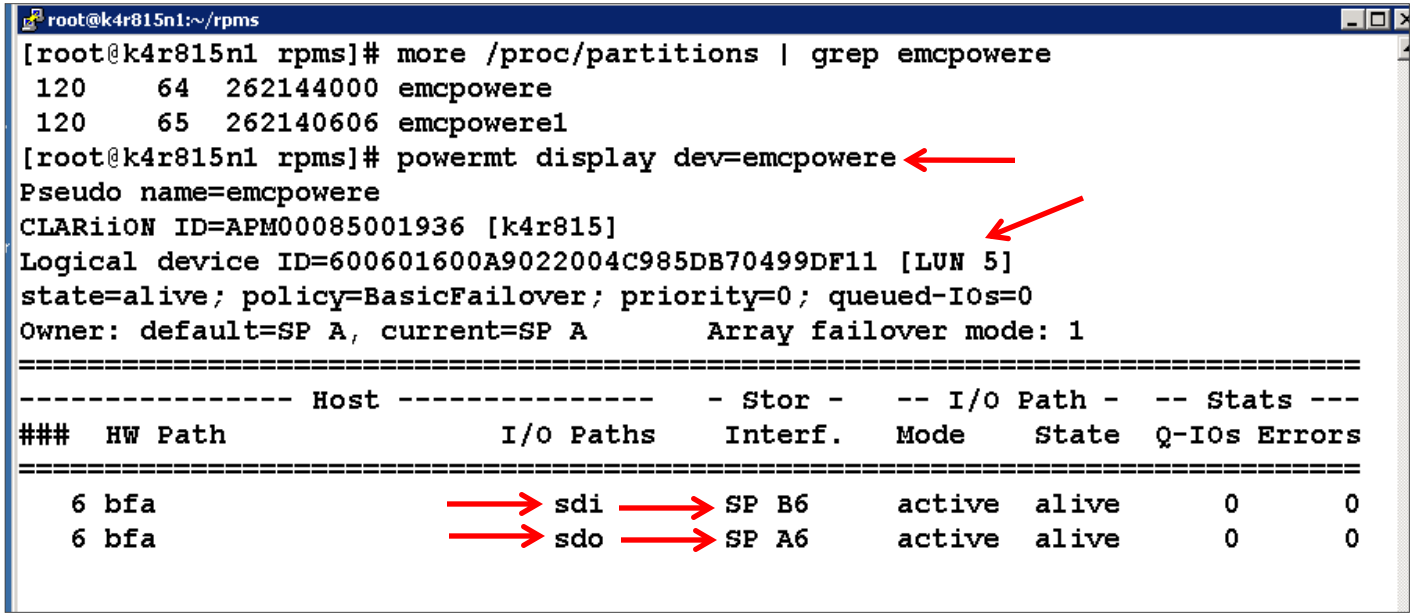
- Example for EMC PowerPath driver for EMC storage:
  - Install EMC PowerPath and Naviagent software:

rpm –ivh EMCpower.LINUX-5.3.0.00.00-185.rhel5.x86_64.rpm
rpm –ivh NaviHostAgent-Linux-64-x86-en_US-6.29.5.0.66-1.x86_64.rpm

- Start naviagent agent and PowerPath daemons:

  service naviagent start , service PowerPath start

- Verify EMC pseudo devices in /proc/partitions:



Shared Storage Configuration

- Block Devices vs Raw Devices vs ASM diskgroup
  - RHEL4: 10g: raw devices for 10g, 11gR1: block devices for 11g R2: ASM diskgroup
  - For RHEL 5: raw device service is depreciated:
  - 10g: use udev rules to define the raw devices
  - 11g R1 clusterware: use block devices:

    set the proper ownerships and permissions in /etc/rc.local file

    ```
    chown root:oinstall /dev/mapper/ocr*
    chmod 0640 /dev/mapper/ocr*
    chown oracle:oinstall /dev/mapper/voting*
    chmod 0640 /dev/mapper/voting*
    ```
  - 11g R2 clusterware: Store OCR and Voting disk in ASM
- Configure ASM(Automatic Storage Management)
  - Volume manager and file systems for Oracle database files, OCR, Voting disk, ACFS Cluster file system
  - Benefits: *Provide file systems accessible from more servers*
    Even distributed IO workload on physical disks
    Provide High Availability option
    Rebalancing allows to change disk online
    Oracle ACFS go beyond of database files

Shared Storage Configuration

- ASM software: Installed as a part of Grid infrastructure(GI)
- Configure ASM Lib and Create ASM disks

. Consistent device naming and permission persistency in Linux (These can be done using the device mapper)

. Provide additional data integrity protection

. Install the ASMLIB library: Load ASMlib rpms on Linux

. Configure ASM LIB: *service oracleasm configure*

. Create ASM disk: *service oracleasm createdisk DATA /dev/emcpowerd1*

$service oracleasm listdisks

$service oracleasm –p querydisks OCR1

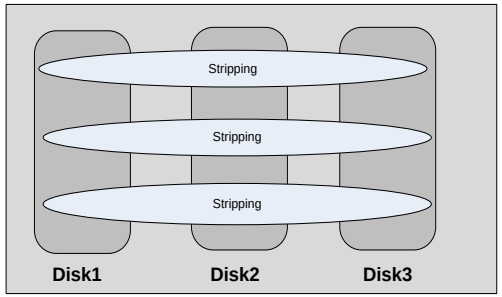
. Setting ORACLEASM_SCANORDER, ORACLEASM_SCANORDEREXCLUDE in /etc/sysconfig/oracleasm for ASMLib to scan the multipath disks and ignore the single path disks, metalink note: #309815.1

```
root@k4r815n1:/dev/oracleasm/disks
[root@k4r815n1 disks]# ls -l /dev/oracleasm/disks
total 0
brw-rw---- 1 grid asmadmin 8,  81 Nov 19 10:35 ACFS
brw-rw---- 1 grid asmadmin 8,  49 Nov 19 10:35 DATA
brw-rw---- 1 grid asmadmin 8, 129 Nov 19 10:35 DATA1
brw-rw---- 1 grid asmadmin 8,  65 Nov 19 10:35 FRA
brw-rw---- 1 grid asmadmin 8,  97 Nov 19 10:35 OCR1
brw-rw---- 1 grid asmadmin 8,  98 Nov 19 10:35 OCR2
brw-rw---- 1 grid asmadmin 8,  99 Nov 19 10:35 OCR3
```

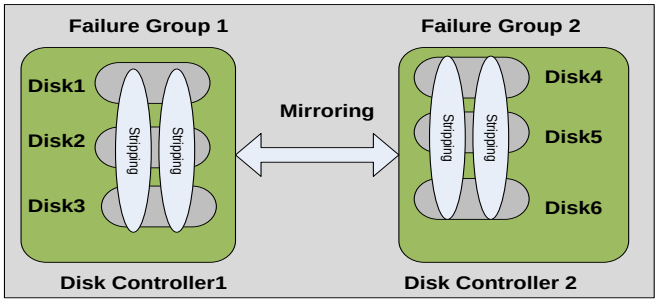
Shared Storage Configuration

– ASM failure group: mirroring/redundancy level setting:
External :no ASM mirroring, rely on external redundancy

ASM Disk Group with External Redundancy

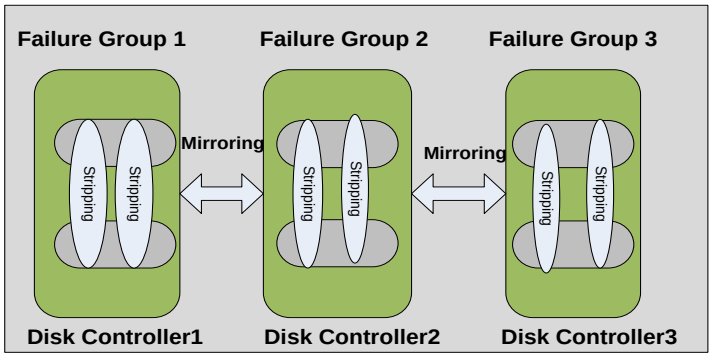


ASM Disk Group with Normal Redundancy



Normal : 2-way mirroring, two failure groups
High: 3-way mirroring three failures groups.

ASM Disk Group with High Redundancy



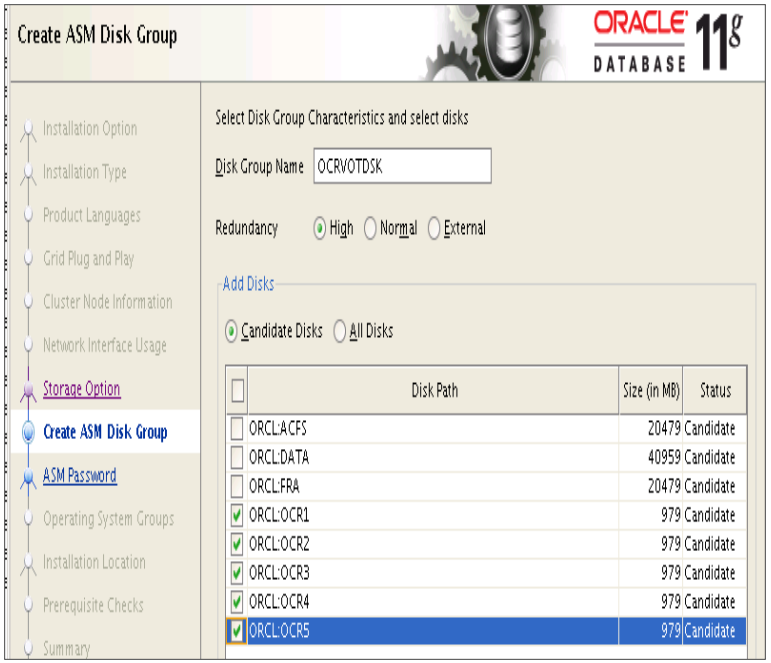
ASM failure groups

```
SQL>  create diskgroup new_group HIGH
REDUNDANCY
    failgroup fg1 disk
  'ORCL:NEWD1' name newd1,
    'ORCL:NEWD2' name newd2
  failgroup fg2 disk
  'ORCL:NEWD3' name newd3,
     'ORCL:NEWD4'  name newd4
  failgroup fg3 disk
  'ORCL:NEWD5' name newd5,
  'ORCL:NEWD6' name newd6;
```

Shared Storage Configuration

- ASM diskgroup for OCR and Voting disks:

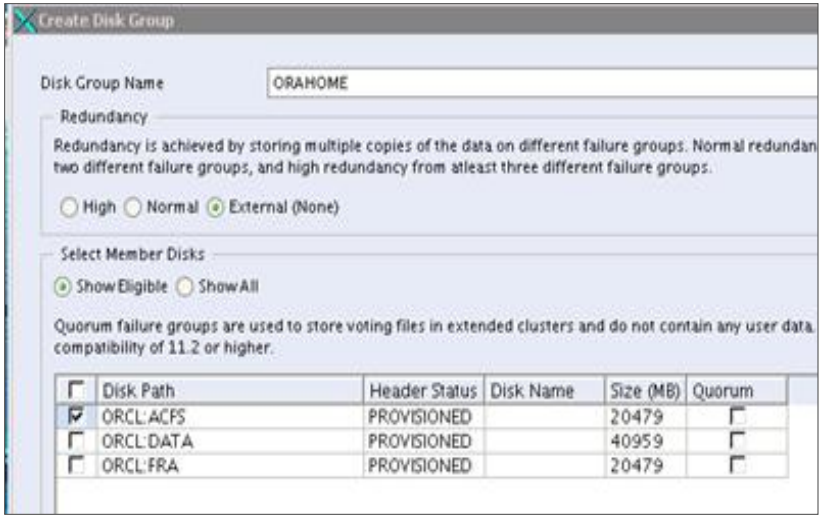
  External Redundancy: relay on external RAID configuration
  Normal Redundancy (3 failure groups): 3 voting disks
  High Redundancy (5 failure group): 5 voting disks
  1 OCR + up to 5 copies: one per diskgroup
  A quorum failure group: only used for OCR and votingdisk

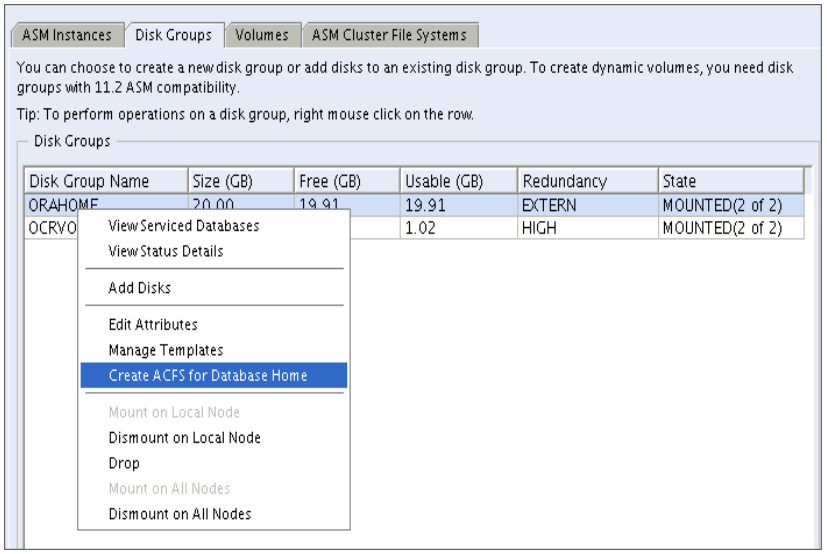


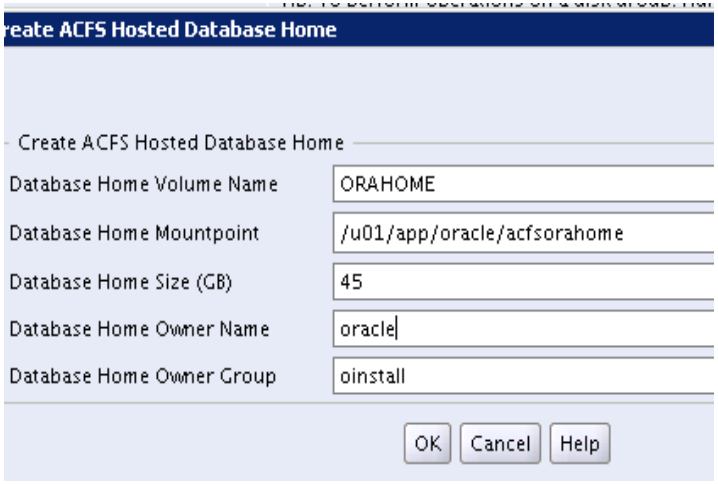

```
grid@k4r815n1:~

SQL> select path ||' ' || name ||' ' || GROUP_NUMBER ||' ' || FAILGROUP
  2   from v$asm_disk where name like 'OCR%';

PATH||''||NAME||''||GROUP_NUMBER||''||FAILGROUP
--------------------------------------------------------------------------------
ORCL:OCR1 OCR1 4 OCR1
ORCL:OCR2 OCR2 4 OCR2
ORCL:OCR3 OCR3 4 OCR3
ORCL:OCR4 OCR4 4 OCR4
ORCL:OCR5 OCR5 4 OCR5

SQL> !crsctl query css votedisk
##  STATE    File Universal Id                File Name Disk group
--  -----    -----------------                --------- ---------
 1. ONLINE   6f26b70a85a84f56bf41a1d4d6e87661 (ORCL:OCR5) [OCRVOTDSK]
 2. ONLINE   19546d7b121e4fc6bfc6f224f4fd9de7 (ORCL:OCR4) [OCRVOTDSK]
 3. ONLINE   30e8391c66d54f82bfc5bc8ed239680c (ORCL:OCR3) [OCRVOTDSK]
 4. ONLINE   06f800a529ad4f02bf45808b04c15683 (ORCL:OCR2) [OCRVOTDSK]
 5. ONLINE   6bc4818a35d44ffebf95aaa31831cfb3 (ORCL:OCR1) [OCRVOTDSK]
Located 5 voting disk(s).
```

Shared Storage Configuration

– Create ACFS cluster file system for shared RAC Oracle Home



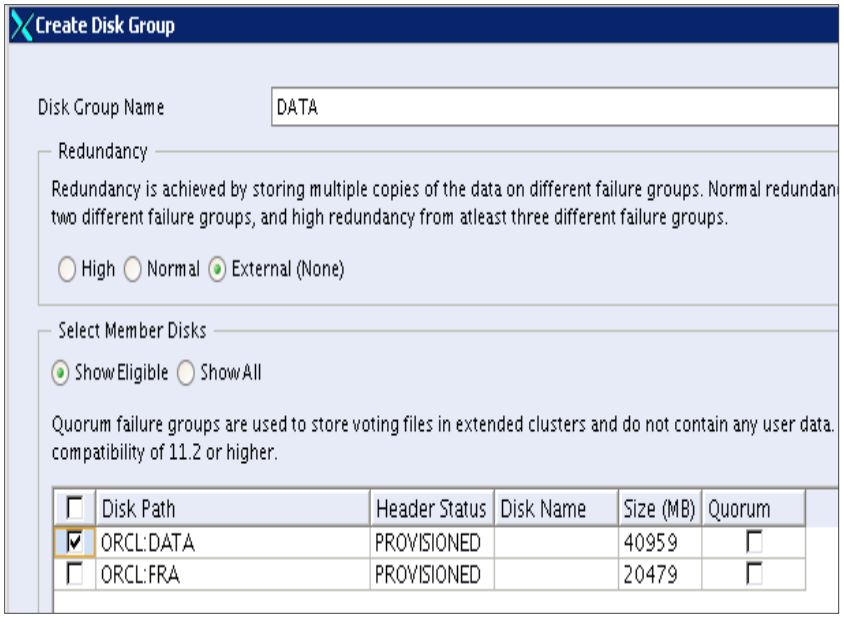


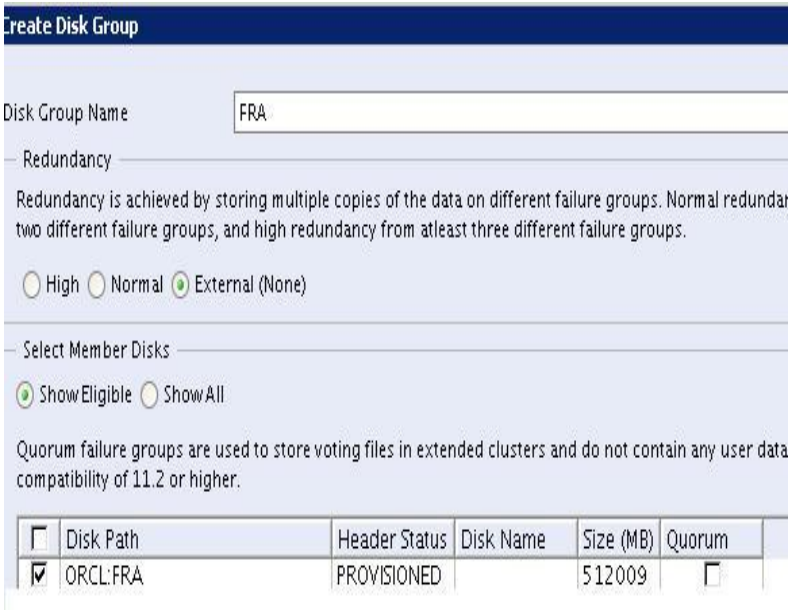



```
[root@owirac1 app]# df -k
Filesystem      1K-blocks     Used Available Use% Mounted on
/dev/xvda2       10498192  9755008    635148  94% /
/dev/xvda1          93307    14285     74205  17% /boot
tmpfs             4194304   171116   4023188   5% /dev/shm
/dev/asm/orahome-10 47185920 159172 47026748   1% /u01/app/oracle/acfsorahome
```

Shared Storage Configuration

– Create ASM diskgroups for Database through asmca:






```
SQL> Select   g.name   group_name  ,  d.path   disk_path
  2   from V$asm_disk d, v$asm_diskgroup g
  3   where d.GROUP_NUMBER = g.GROUP_NUMBER;

GROUP_NAME          DISK_PATH
------------------- ----------------
ORAHOME             ORCL:ACFS
DATA                ORCL:DATA
FRA                 ORCL:FRA
OCRVOTDSK           ORCL:OCR1
OCRVOTDSK           ORCL:OCR2
OCRVOTDSK           ORCL:OCR3
OCRVOTDSK           ORCL:OCR4
OCRVOTDSK           ORCL:OCR5
```

Shared Storage Configuration

- ASM Rebalancing and Online Storage Migration
  - Example of performing online storage migration
    Migrate from DATA1-2 on CX3-80 to DATA3-4 on EqualLogic
  - Steps:
    - Create two volumes DATA3-4, the same size as DATA1-2
    - All database nodes have access to DATA3, DATA4
    - Create two new ASM disks on DATA3,DATA4
    - Replace DATA1,DATA2 with DATA3, DATA4

```
SQL>alter diskgroup DATA_DG  add disk
 'ORCL:DATA3' name DATA3, 'ORCL:DATA4' name DATA3
 drop disk DATA1, DATA2 rebalance power 8;
```

    - Check rebalance status from v$ASM_OPERATION

```
SQL>select GROUP_NUMBER, SOFAR,  EST_MINUTES
from  V$asm_operation;
```

GROUP_NUMBER	SOFAR	EST_MINUTES
1	18749	29

Network Configuration

Network Configuration

- *Public Network configuration: virtual IPs*
  - *Virtual IP: failed over to a survived node, no timeout*
  - *SCAN* (11gR2): a single name of a cluster
    It has three 3 listeners, 3 virtual IPs,
- Three ways to configure SCAN VIPs
  - DNS: add three entries to DNS:
  - GNS: assigned through DHCP of GNS(Grid Naming Services)
  - Added into /etc/hosts, only for test environment, only one SCANIP
- How to Set up SCAN in DNS:
  1) In DNS server: /etc/named/<domain>.zone: add the entries:

```
km915-scan              IN   A     172.16.150.110
km915-scan              IN   A     172.16.150.111
km915-scan              IN   A     172.16.150.112
km915-N1-VIP  IN   A     172.16.150.210
km915-N2-VIP  IN   A     172.16.150.211
```

  2) One each cluster node: Add to the /etc/resolv.conf:

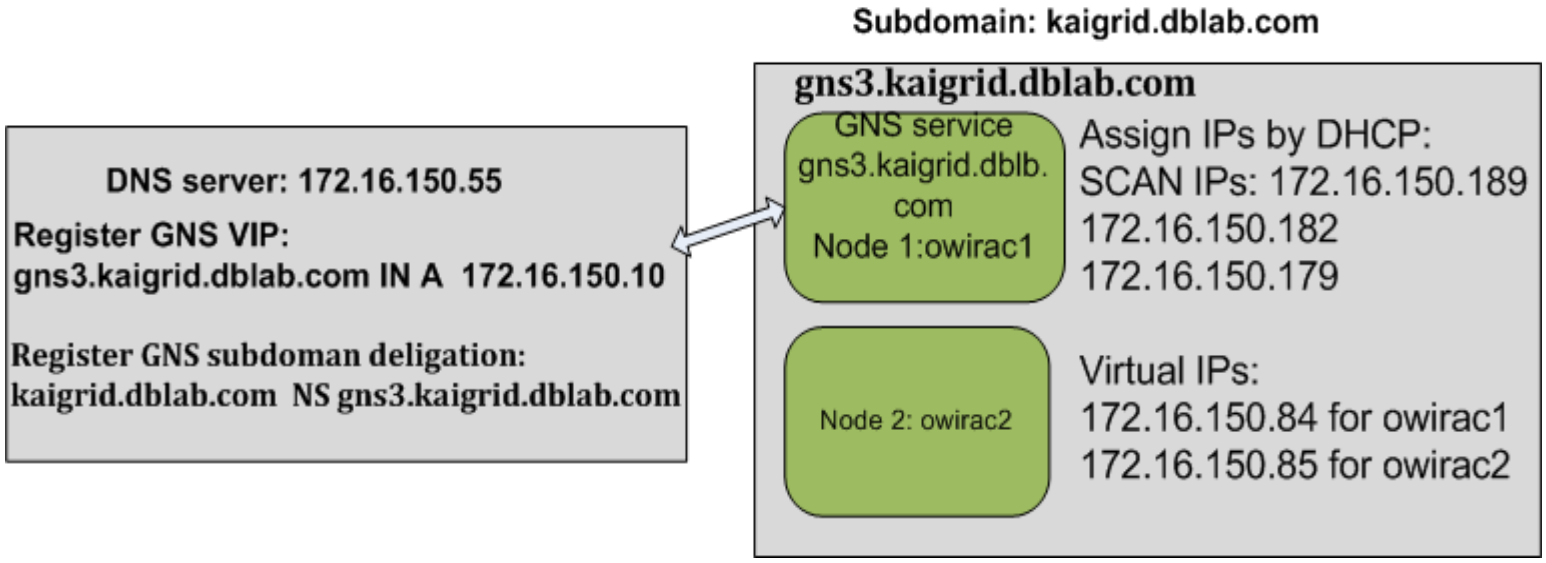
```
nameserver:   172.16.150.55
search dblab,com
```

  Details: refer to Metalink Support Notes: #1107295.

Network Configuration

How GNS service works:

1) Instead of putting the virtual VIPs and SCAN IPs in DNS,
   DNS only lists the static GNS VIP and mapping of domain to GNS name
2) DHCP server provide the dynamic IPs for all the VIPs and SCAN VIPs
3) All dynamic VIPs registered in GNS service.
4) DNS forwards every request of the host in the domain to GNS such as
   xxxx.kaigrid.dblab.com ➔ gns.kaigrid.dblab.com



Network Configuration

How to setup GNS service through 11gR2 clusterware installation

- On DNS server:

Specify GNS VIP in DNS **: gns3.kaigrid.dblab.com IN A 172.16.150.10**

Specify GNS Subdomain **: kaigrid.dblab.com NS gns3.kaigrid.dblab.com**

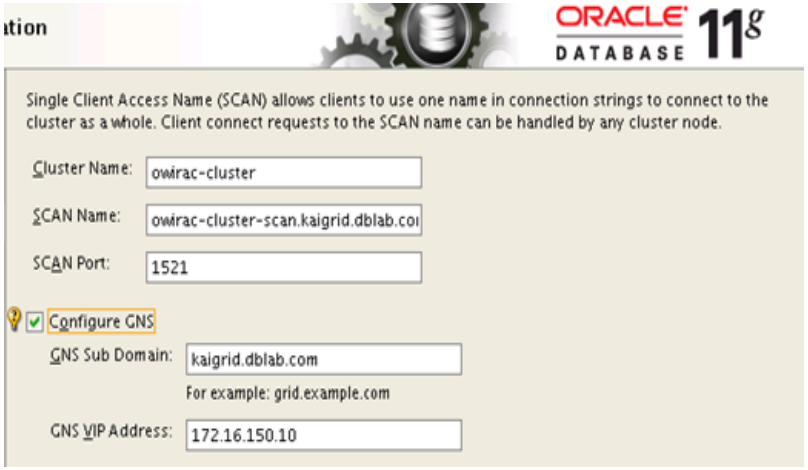
- ON Cluster Nodes: Add entries to /etc/resolv.conf
- Fill out the GNS, SCAN and cluster information on GI installation

```
[root@owirac1 sysconfig]# more /etc/resolv.conf
; generated by /sbin/dhclient-script
;nameserver 10.9.160.254
options attempts: 2
options timeout: 1
nameserver 172.16.150.10
nameserver 172.16.150.55
search kaigrid.dblab.com dblab.com
[root@owirac1 sysconfig]#
```

GNS Address

DNS Address

SubDomain for Cluster



For Details of GNS configuration, Refer to Metalink Support Note # 946452.1

Network Configuration

11gR2 GI(Grid Infrastructure) installation

- Creates GNS service and GNS VIP
- Assigns VIPs and SCAN IPs through DHCP from GNS

```
[root@owirac1 sysconfig]# srvctl config scan
SCAN name: owirac-cluster-scan.kaigrid.dblab.com, Network: 1/17
SCAN VIP name: scan1, IP: /172.16.150.189/172.16.150.189
SCAN VIP name: scan2, IP: /172.16.150.182/172.16.150.182
SCAN VIP name: scan3, IP: /172.16.150.179/172.16.150.179
```

```
[root@owirac1 sysconfig]# srvctl config vip -n owirac1
VIP exists.:owirac1
VIP exists.: /172.16.150.84/172.16.150.84/255.255.0.0/eth0
```

- Creates three SCAN listeners

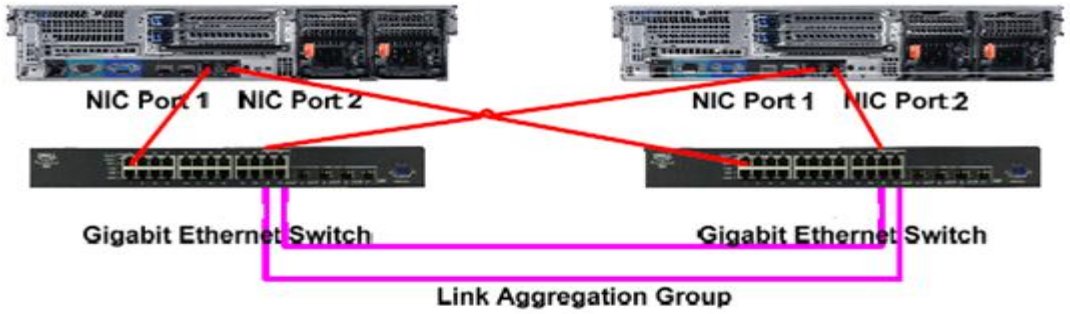
```
[root@owirac1 ~]# srvctl config scan_listener
SCAN Listener LISTENER_SCAN1 exists. Port: TCP:1521
SCAN Listener LISTENER_SCAN2 exists. Port: TCP:1521
SCAN Listener LISTENER_SCAN3 exists. Port: TCP:1521
```

. Clusterware manages the high availability of GNS and GNS VIP

Network Configuration

- Private Interconnection Configuration
  - Fully Redundant Ethernet Interconnects:

    Two NIC cards, two non-roundtable interconnect switches



  - NIC teaming to bond two network interfaces for failover

    ifcfg-eth1: DEVICE=eth1 SLAVE=yes

    ifcfg-eth2: DEVICE=eth2 SLAVE=yes

    ifcfg-bond0: IPADDR=192.168.9.52 BOOTPROTO=none
  - Configuration best practices from Oracle
    - Separate from the public network
    - Set UDP send/receive buffers to max
    - Use the same interconnect for both Oracle clusterware and Oracle RAC communication

Network Configuration

- NIC settings for interconnect:
  1. Define control : rx=on, tx=off
  2. Ensure NIC names/slots order identical on all nodes:
  3. Configure interconnect NICs on fastest PCI bus
  4. Compatible switch settings:

     802.3ad on NICs = 802.3ad on switch ports

     MTU=9000 on NICs = MTU=9000 on switch ports
- Recommended minimum Linux kernel configuration for networking

  net.core.rmem_default , net.core.rmem_max, net.core.wmem_default, net.core.wmem_max
- Network Heartbeat Misscount: 60 secs for 10g, 30 secs for 11g
- Oprocd, hangcheck replaced by css daemon Agent &monitor in 11gR2
- Redundant Interconnect Usage: on Linux/Unix in 11.2.0.2:

  use up to four high available virtual IPs (the HAIP)

  Load balancing and failure protection: automatic relocation.

  no need of bonding and trucking

  **Known issue with HAIP: if one the private NIC fails, HAIP doesn't fail over the private interconnection to other NIC. it causes node evictions: BUG – 12325672, Doc ID 1323995.1.

  Fixed in 11.2.0.3 , patch 12310608 or patch 12546712

Managing Oracle clusterware

Managing Oracle Clusterware

- Managing voting disks
  - Locate voting disk: crsctl query votedisk css
  - *Set odd number of voting disks, 1/3/5 by defaults*
  - Store Voting disks on ASM

    One votingdisk per one failure group for redundancy

```
grid@k4r815n1:~

SQL> select path ||' ' || name ||' ' || GROUP_NUMBER ||' ' || FAILGROUP
  2    from v$asm_disk where name like 'OCR%';

PATH||''||NAME||''||GROUP_NUMBER||''||FAILGROUP
--------------------------------------------------------------------------------
ORCL:OCR1 OCR1 4 OCR1
ORCL:OCR2 OCR2 4 OCR2
ORCL:OCR3 OCR3 4 OCR3
ORCL:OCR4 OCR4 4 OCR4
ORCL:OCR5 OCR5 4 OCR5

SQL> !crsctl query css votedisk
##  STATE    File Universal Id                File Name Disk group
--  -----    -----------------                --------- ---------
 1. ONLINE   6f26b70a85a84f56bf41a1d4d6e87661 (ORCL:OCR5) [OCRVOTDSK]
 2. ONLINE   19546d7b121e4fc6bfc6f224f4fd9de7 (ORCL:OCR4) [OCRVOTDSK]
 3. ONLINE   30e8391c66d54f82bfc5bc8ed239680c (ORCL:OCR3) [OCRVOTDSK]
 4. ONLINE   06f800a529ad4f02bf45808b04c15683 (ORCL:OCR2) [OCRVOTDSK]
 5. ONLINE   6bc4818a35d44ffebf95aaa31831cfb3 (ORCL:OCR1) [OCRVOTDSK]
Located 5 voting disk(s).
```

  - Voting disk is backed up automatically in 11gR2
  - crsctl commands to add, delete, replace voting disk.
  - Restore voting disk: . Restore OCR if OCR corrupted
    - . Start crs in exclusive mode: *crsctl start crs –excl*
    - *. Add new votingdisk: crsctl replace votedisk +asm_disk_group*
    - . Restart crs

Managing Oracle clusterware

- Managing OCR
  - Locate OCR:

```
grid@k4r815n1:~
[grid@k4r815n1 ~]$ ocrcheck
Status of Oracle Cluster Registry is as follows :
         Version                  :          3
         Total space (kbytes)     :     262120
         Used space (kbytes)      :       2860
         Available space (kbytes) :     259260
         ID                       :  232227200
         Device/File Name         : +OCRVOTDSK
                                    Device/File integrity check succeeded
         Cluster registry integrity check succeeded
```

  - Migrate OCR to ASM: a. add new ASM diskgroup
    b. *ocrconfig -add +new_diskgroup*
    c. *ocrconfig –delete old_location*
  - Backup OCR: automatic: *ocrconfig –showbackup*
    manual: *ocrconfig -manualbackup*
  - Restore OCR: stop clusterware: *crsctl stop*
    run restore command*: crs ocrconfig –restore*
  - Diagnose OCR problem: OCRDUMP and OCRCHECK
  - *Export OCR: ocrconfig -export*
  - Import OCR: ocrconfig –import

Clusterware Troubleshooting

Clusterware Troubleshooting

- Clusterware utility: crsctl for check, start, and stop ops
  - crsctl –help, crsctl <command_name> -h
  - Check health of the cluster:

```
grid@k4r815n1:~
[grid@k4r815n1 ~]$ crsctl check crs
CRS-4638: Oracle High Availability Services is online
CRS-4537: Cluster Ready Services is online
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
[grid@k4r815n1 ~]$ crsctl check cluster -all
**************************************************************
k4r815n1:
CRS-4537: Cluster Ready Services is online
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
**************************************************************
k4r815n2:
CRS-4537: Cluster Ready Services is online
CRS-4529: Cluster Synchronization Services is online
CRS-4533: Event Manager is online
**************************************************************
```

- Log files and troubleshooting

  Log files locations:

$GIRD_Home/log/<host>/alert<host>.log
$GIRD_Home/log/<host>/<process>/

```
grid@k4r815n1:/opt/app/11.2.0/grid/log/k4r815n1/admin
[grid@k4r815n1 k4r815n1]$ pwd
/opt/app/11.2.0/grid/log/k4r815n1
[grid@k4r815n1 k4r815n1]$ ls -lrt | cut -
total
drwxr-x--- grid oinstall diskmon
drwxr-x--- root oinstall ohasd
drwxr-x--- grid oinstall cssd
drwxr-x--- root oinstall crsd
drwxr-x--- grid oinstall gpnpd
drwxr-x--- grid oinstall srvm
-rw-rw-r-- root root alertk4r815n1.log
drwxr-x--- grid oinstall client
drwxr-x--- root oinstall ctssd
drwxr-x--- root oinstall gnsd
drwxrwxr-t grid oinstall racg
drwxr-x--- grid oinstall mdnsd
drwxr-x--- grid oinstall gipcd
drwxr-x--- grid oinstall evmd
drwxrwxr-t root oinstall agent
drwxr-x--- grid oinstall admin
```

Clusterware Troubleshooting

- Node eviction
  - Split brain condition: a node failure partitions the cluster into multiple sub-clusters without knowledge of the existence of others
    Possible causes: not responding network heartbeat, disk heartbeat, a hung node or hung ocssd.bin process
  - Consequence: data collision and corruption
  - IO fencing: fencing the failed node off from all the IOs: STOMITH (Shoot The Other Machine In The Head) algorithm
  - Node eviction: pick a cluster node as victim to reboot.
    Always keep the largest cluster possible up, evicted other nodes
    two nodes: keep the lowest number node up and evict other
  - Two CSS heartbeats and misscounts to detect node eviction
    1. Network HeartBeat (NHB) : cross the private interconnect establish and confirm valid node membership
       CSS misscount: 30 seconds
    2. Disk heartbeat : between the cluster node and voting disk
       CSS misscount, the default is 200 seconds

Clusterware Troubleshooting

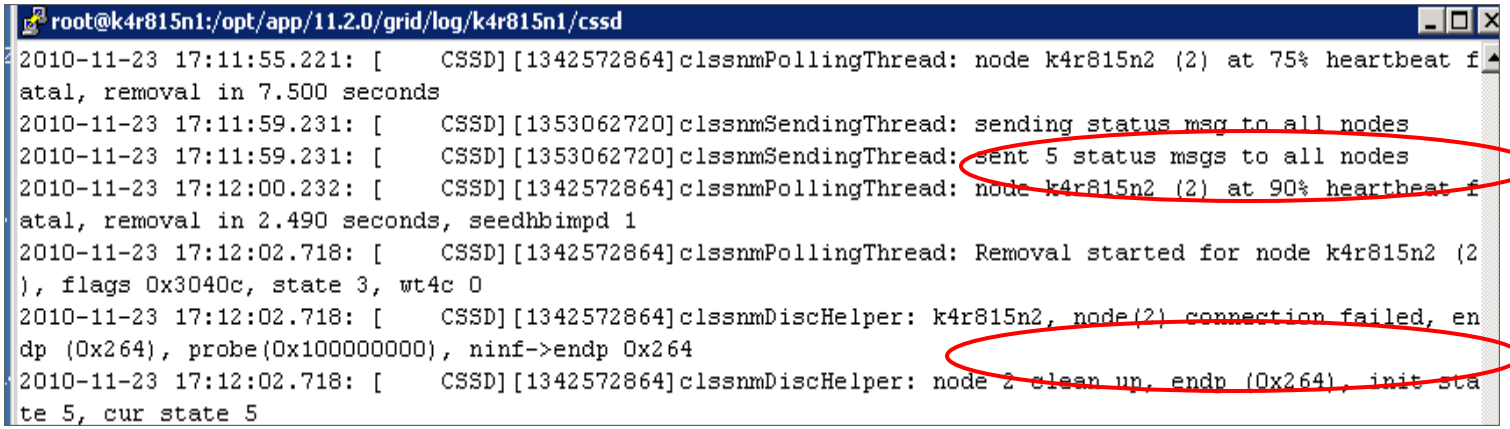
- Node Eviction and Clusterware Reboots:
  - Processes related to reboot
    - OCSSD (CSS damon): internode health monitoring, monitor a network heartbeat and a disk heartbeat, can evict a node
    - CSSDAGENT: spawning the OCSSD process, monitoring for node
    - CSSDMONITOR: monitors for node hangs, monitors the OCSSD process, monitoring to the OCSSD process for hangs
    - OCSSD (CSS damon): internode health monitoring, monitor
  - Critical errors in the logfiles in $GRID_HOME>/log/<nodename>/
    - Clusterware alert log: alert<node_name>.log
    - cssdagent log(s) in ~agent/ohasd/oracssdagent_root
    - cssdmonitor log(s) in ~agent/ohasd/oracssdmonitor_root
    - ocssd log(s) in ~ cssd
  - Message files:
    - Linux: /var/log/messages
    - Sun: /var/adm/messages
    - HP-UX: /var/adm/syslog/syslog.log
    - IBM: /bin/errpt -a > messages.out

Clusterware Troubleshooting

- Troubleshooting node eviction
  - Common causes for OCSSD eviction:
    network failure latency exceeds CSS miscount 30 seconds
    Problem with access disk determined by CSS misscount 200 sec
    OCSSD failure,
  - Common causes of : CSSDAGENT OR CSSDMONITOR eviction:
    OS scheduler problem caused by OS locked up in driver or hardware or the heavy loads; thread of CSS demon hung
  - Review the log files, refer to metalink note [1050693.1]

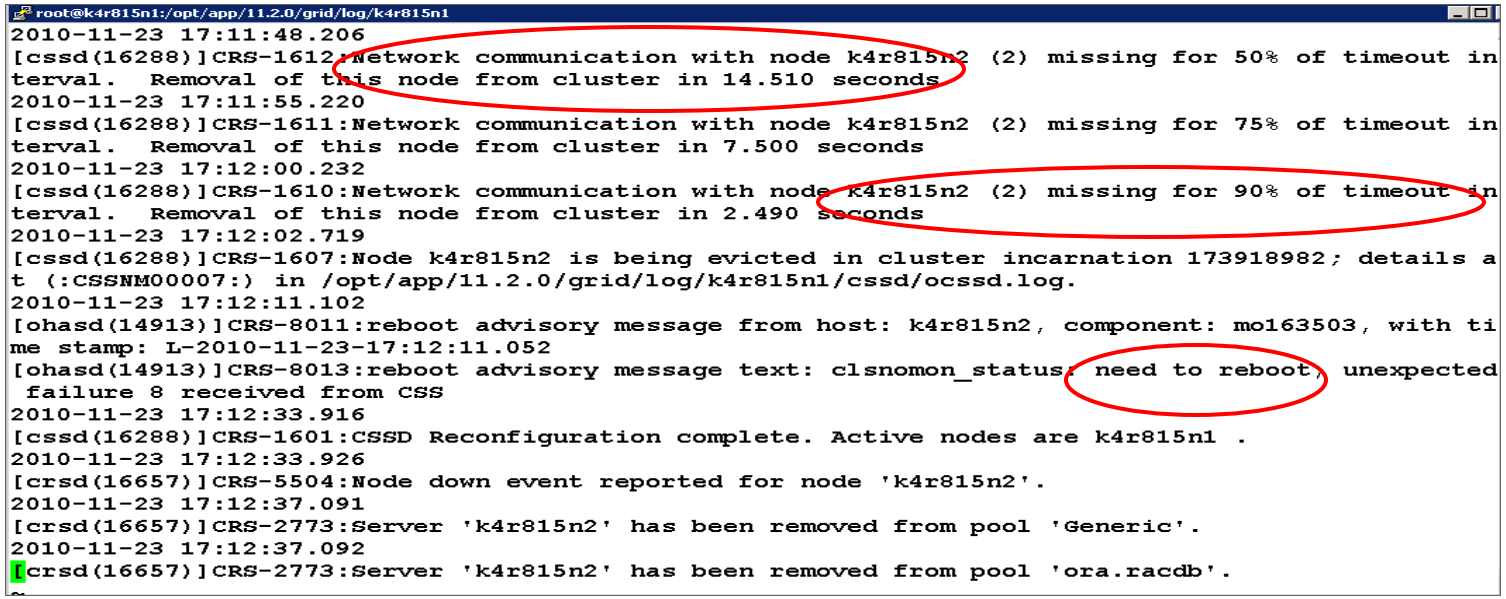
- Node Eviction Diagnosis Case Study
  - Case 1 :Node 2 was rebooted in a 2-node 11g R2 cluster on Linux:

OCSSD log: $CRS_HOME/log/<hostname>/cssd/ocssd.log file in Node1:



Clusterware Troubleshooting

alertk4r815n1.log



Root cause analysis:

A network heartbeat failure triggered node 2 eviction. Found a losing network cable in the single network connection for private interconnect

Solution : Add a redundant network connection with dedicated switch and establishing the network bonding of two network interfaces

Clusterware Troubleshooting

- Case: Node 2 was evicted and rebooted due to losing storage connections

```
2010-11-23 18:10:33.162: [    CSSD][1137047872]clssnmvSchedDiskThreads: DiskPingMonitorThread sched
 delay 950 > margin 750 cur_ms 2370744 lastalive 2369794
2010-11-23 18:10:35.773: [    CSSD][1357334848]clssnmSendingThread: sending status msg to all nodes
2010-11-23 18:10:35.773: [    CSSD][1357334848]clssnmSendingThread: sent 5 status msgs to all nodes
2010-11-23 18:10:38.689: [    CSSD][1346844992]clssnmPollingThread: node k4r815n1 (1) at 75% heartb
eat fatal, removal in 7.080 seconds
```

```
2010-11-23 18:10:43.699: [    CSSD][1346844992]clssnmPollingThread: node k4r815n1 (1) at 90% heartb
eat fatal, removal in 2.070 seconds, seedhbimpd 1
2010-11-23 18:10:45.766: [    CSSD][1346844992]clssnmPollingThread: Removal started for node k4r815
n1 (1), flags 0x6040e, state 3, wt4c 0
2010-11-23 18:10:45.766: [    CSSD][1346844992]clssnmDiscHelper: k4r815n1, node(1) connection faile
d, endp (0x30c), probe(0x100000000), ninf->endp 0x30c
2010-11-23 18:10:45.766: [    CSSD][1346844992]clssnmDiscHelper: node 1 clean up, endp (0x30c), ini
t state 5, cur state 5
```

```
[cssd(16288)]CRS-1604:CSSD voting file is offline: ORCL:OCR2; details at (:CSSNM00058:) in /opt/app
/11.2.0/grid/log/k4r815n1/cssd/ocssd.log.
2010-11-23 18:10:15.898
[cssd(16288)]CRS-1606:The number of voting files available, 0, is less than the minimum number of v
oting files required, 3, resulting in CSSD termination to ensure data integrity; details at (:CSSNM
00018:) in /opt/app/11.2.0/grid/log/k4r815n1/cssd/ocssd.log
2010-11-23 18:23:52.704
[ohasd(9966)]CRS-2112:The OLR service started on node k4r815n1.
2010-11-23 18:23:53.424
[ohasd(9966)]CRS-8017:location: /etc/oracle/lastgasp has 56 reboot advisory log files, 0 were annou
nced and 0 errors occurred
```

Clusterware Troubleshooting

– Case 3: Random node evicted in a 11-node 10g R2 cluster on Linux:
/var/log/messages:

Jul 23 11:15:23 racdb7 logger: Oracle clsomon failed with fatal status 12.
Jul 23 11:15:23 racdb7 logger: Oracle CSSD failure 134.
Jul 23 11:15:23 racdb7 logger: Oracle CRS failure. Rebooting for cluster integrity

OCSSD log: $CRS_HOME/log/<hostname>/cssd/ocssd.log file

[CSSD]2008-07-23 11:14:49.150 [1199618400] >WARNING:
clssnmPollingThread: node racdb7 (7) at 50% heartbeat fatal, eviction in 29.720 seconds
..
clssnmPollingThread: node racdb7 (7) at 90% heartbeat fatal, eviction in 0.550 seconds
…
[CSSD]2008-07-23 11:15:19.079 [1220598112] >TRACE:
clssnmDoSyncUpdate: Terminating node 7, racdb7, misstime(60200) state(3)

Root cause analysis:

- A network heartbeat failure triggered a node eviction on node 7
- Private IP node not pingable right before the node eviction
- Public and private shared a single physical switch

– Solution : Use two dedicated switches for interconnect
– Result: no more node eviction after the switch change

Clusterware Troubleshooting

- RAC Diagnostic Tools:
  - Diagwait:
    - Delay the node reboot for a short time to write all diagnostic messages to the logs.
    - Doesn't increase of probability of data corruption
    - Setup step for 10g and 11gR1: crsctl set css diagwait 13 –force
    - 13 seconds is set by default in 11gR2
  - Cluster Health Monitor(IPD/OS):
    - A set of tools to collect OS performance data
    - Monitor and record resources degradation and failure related to oracle clusterware and Oracle RAC issue, help to troubleshoot eviction caused by the scheduler issues or high CPU load
    - Historical mode goes back to the time before node eviction
    - Details to refer to Metalink Note [736752.1]
  - RAC-RDDT and Oswatcher: Metalink #301138.1, #301137.1
    - Collect information leading up to the time of reboot.
    - From OS utilities: netstat, iostat, vmstat
    - Start: ./startOSW.sh 60 10

Summary

- Oracle 11g R2 Clusterware Architecture
- Storage Configuration
- Network Configuration
- Managing Oracle Clusterware
- Clusterware Troubleshooting

Thank You and QA

Contact me at kai_yu@dell.com or visit my Oracle Blog at http://kyuoracleblog.wordpress.com/

My OOW 2011 Conference Presentation Schedules

Posted by: **kyuoracleblog** | August 13, 2011

I will present or participlate as a panellist of the following OOW sessions:

1. Ensure the High Availability and Stability of Oracle RAC: Storage and Network Side Story , Session ≠09385, 10/2/2011, Sunday, 01:30 PM, Moscone West – 2005

*2.*Launching the IOUG Virtualization SIG: 360 Degrees of Virtualization for Oracle DBA... , session #28900, IOUG Virtualization panel, 10/2, Sunday, 04:00 PM, Moscone West – 2009

3. Consolidate Oracle E-Business Suite Databas in Oracle Database 11g Release 2 Grid: Case Study, session≠08945, 10/4/2011, Tuesday, 10:15 AM, Intercontinental – Intercontinental Ballroom A

4. Configuring and Managing a Private Cloud with Oracle Enterprise Manager , Oracle OpenWorld 2011 session≠06980 , 10/4/2011, Tuesday, 05:30 PM, Moscone South – 309, San Franscio

5. Upgrading Oracle Enterprise Manager, Using Best Practices , Oracle OpenWorld 2011 session≠0733, 10/6/2011, Thursday, 01:30 PM, Intercontinental – Intercontinental Ballroom A

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