High Availability Infrastructure for Cloud Computing

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About Author

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  – 17 years with Oracle Technology: DBA, Apps DBA, Architect
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Agenda

• High Availability Requirements in Cloud Computing
• Hardware Infrastructure for High Availability
• System Architecture for High Availability
• Considerations to Reduce Migration Downtime
• QA
High Availability Requirements in Cloud

- **What is meant by High Availability?**
  - Defined by Service Level Agreement (SLA):
  - HA goal is to meet SLA requirement
  - Balance between the availability and implementation cost
  - SLA: for example, 99.95%, annual 4 hrs 22 minutes downtime
    
    Downtime window: first Saturday: 8pm-10pm every quarter

- **Cases impacting system availability:**
  - Service outage by unplanned downtime:
    - hardware or software failure, human error
  - Service disruption by planned downtime:
    - hardware/software upgrade, patching and migration from old system to new system
  - Service performance degrade: violate performance SLA
    for example, 99% transactions finished in a 2 seconds window
High Availability Requirements in Cloud

- **High Availability SLA in Cloud Environment**
  - Consolidation of databases and applications in Cloud
  - Applications share the same cloud infrastructure
  - Great business impact due to the cloud infrastructure downtime
  - Applications may have different SLAs for different business:
    - Private cloud serves applications from different time zones
    - Public cloud serves different customers applications
    - Very difficult to find downtime to meet all the SLAs

- **Architect a High Availability Cloud Infrastructure**
  - How to design high available infrastructure for cloud
  - Architect hardware infrastructure to reduce unplanned outage
  - Design system architecture to minimize the planned/unplanned outage
  - Use configuration and implementation best practices for HA
  - Minimize downtime during system migration
  - Establish the pre-active real time monitoring system
Hardware Infrastructure for High Availability

- **High Availability Storage Infrastructure**
  - Storage HA plays a key role in the infrastructure HA
  - Redundant IO paths from servers to storage array
    
    Server <-> HBAs <-> Switches <-> Storage Controllers <-> Disk Enclosures
Hardware Infrastructure for High Availability

- Redundant IO paths from servers to storage array
  storage zoning: (HBA1, Switch1, Volume), (HBA1, Switch2, Volume),
  (HBA2, Switch1, Volume), (HBA2, Switch2, Volume),

  A storage volume should be able to fail over to another controller

Software multipathing: Two redundant IO paths seen in OS:
  to the same storage volume: /dev/sdb and /dev/sdc

Group them together to alias Data1 using multipathing software

```
multipath {
    wwid 36090a028e093fc906099540639aa2149 #<---- for sdb and sde
    alias Data1 }
```

- SAN Disk Array RAID for Redundancy: Raid 10/5 Configuration
- Redundant Storage Controllers for high availability
- Oracle ASM diskgroup redundancy settings:
Hardware Infrastructure for High Availability

- **Network High Availability Configuration**
  - fully redundant interconnects for cluster configuration

  ![Network Diagram]

  - Network bonding/teaming vs Oracle Highly Available Virtual IP (HAIP)
  - Dedicated switches for private interconnects

- **Redundant Hardware Infrastructure for Cluster Database**

  ![Database Diagram]
High Available System Architecture

- **Oracle Real Application Cluster: Active-active cluster database**
  - Protect database against server failure with automatic failover:
    - Virtual IP (VIP) automatic failover by Oracle clusterware
  - Reduce planned downtime for hardware, OS, software upgrade
  - Application load balancing among nodes

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**Diagram:**

- Single Client Access Name (SCAN)
- VIP
- Service
- Instance
- Listener
- Grid Infrastructure
  - ASM
  - Clusterware
- OS
- OCR, Votingdisk, ACFS
- Data
- Shared Storage
High Available System Architecture

- **Oracle RAC one node database: active-passive database**
  - Protect database against server failure with automatic failover:
    - Virtual IP (VIP) automatic failover by Oracle clusterware
  - Reduce planned downtime for hardware, OS, software upgrade
  - Single node database, no load balancing among nodes

- **Using Oracle clusterware to enable application high availability**
  - Oracle Clusterware manages the high availability of the application
  - If the server fails, clusterware fails over the application to another server
High Available System Architecture

- Oracle VM provides HA against physical server failure
  - Applications run on virtual machines
  - Virtual machines run on a pool of VM servers (VM server pool)
  - Enable HA on the VM server pool as well as on virtual machines
  - Virtual Machine images/storage stored in shared storage
  - Failover to another VM server to reduce unplanned downtime
High Available System Architecture

- **Oracle VM provides live migration to prevent planned downtime**
  - Live migration to another VM server without downtime of VM
  - Migrating the virtual machine to other physical server for:
    - Physical server maintenance
    - Balancing the workload by moving VM to physical server
    - Zero downtime for the virtual machine: OS & applications on the VM
High Available System Architecture

- Oracle RAC one node works with Oracle VM:
  - RAC One Node fully supported in Oracle VM environment.
  - The database will failover to another VM if this VM fails
  - Oracle VM live migration for hardware maintenance
  - RAC One node online relocation for VM and OS maintenance
High Available System Architecture

- **Oracle RAC database works on Oracle VM:**
  - Two possible HA configurations: HA by VM and HA by RAC
  - Only HA by RAC is supported and HA by VM is not supported for RAC database configuration.
High Available System Architecture

**Oracle RAC Database works on Oracle VM:**
- Consolation of multiple RAC databases in fewer physical servers
- Each Database instance runs on its own VM independently
- One database instance node eviction will not impact other databases
- Less impact of downtime during OS and Oracle software upgrade
High Available System Architecture

- Virtualization based Cloud Infrastructure
  - Availability of virtual machines independent from individual physical machines
High Available System Architecture

- Ensure the data availability against storage failure or site failure
  - Physical standby database kept in sync with the primary database with Oracle data guard
  - Protect Modes: maximal protection; maximum availability; maximum performance
  - Switchover/ Failover to standby database
  - Active Data Guard enables queries against the standby database while redo logs are applied in real time
  - Disaster recovery solutions across different data centers

- Oracle RAC + Oracle Data Guard: protect database against server failure, storage failure and site failure
Amazon EC2 Compute Cloud Locations: Regions and Availability Zones
- Eight Regions: US East, US West(OR), US West(CA), EU, Asia Pacific(S), Asia Pacific (Tokyo), South America and AWS GovCloud
- A Region has one or more Availability Zones: engineered to be insulated from failures in other Availability Zones
- Launching application in other Availability Zone in the region to protect application from a location (site) failure.
- Each Region: SLA: 99.5% availability
Reduce Downtime during System Migration

- **System downtime during the migration**
  - Server migration, platform migration (OS), storage migration, database migration
  - Database migration involves migrating all the data to the new system
  - Significant downtime involved. Normally it requires the application downtime during the migration process.

- **Options and considerations to reduce the migration downtime**
  - Applications: build the new system and do the last minute switch
  - Database migration includes the last minute data to the new system
    - Export/import and data pump: need a long database time
    - Transportable tablespaces for across platform migration
    - Data Guard based migration method for across server migration
    - Oracle Golden Gate for online migration
    - Use ASM disk rebalance for online storage migration: online migrate database from old SAN storage to new SAA.
    - Storage replication method by the storage vendor
Thank You and QA

Visit my Oracle Blog at http://kyuoracleblog.wordpress.com

My name is Kai Yu. I am a senior system engineer/consultant architect in Dell Oracle Solutions engineering lab. I have been working on Oracle technologies since 1995. My involvement with Oracle Technologies really came from two different prospects: as a hardcore Oracle Database administrator and Oracle Applications DBA in various IT departments 1995-2006 and as an Oracle solutions architect and system engineer, since 2006, while I focus on...