Best Practices for Consolidation of Oracle on Linux Deployments

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EXECUTIVE OVERVIEW

There are many reasons to deploy Oracle on Linux. The more important ones are the flexibility and non-proprietary characteristics of Linux. But the key advantage is that the entire server side code stack from the OS to the application layer is supported by Oracle. Using the best practices Oracle has used internally to consolidate its own applications on Linux, a lower total cost of ownership can result. Using Linux as yet another deployment platform in a best of breed configuration in and of itself does not necessarily guarantee a lower TCO. It is the efficient consolidation of multiple Oracles on Linux deployments on x86 architectures that can result in a lower TCO.

This paper describes the meaning of consolidation in a production, data center environment. Best practices on different factors that impact consolidation are discussed, namely: stack certification and alignment, migration, rapid installation and cloning, patch/change management across the stack, provisioning, operational management, security, high availability and scalability.

1. INTRODUCTION

With every IT department looking to reduce their infrastructure and operational costs, there is an increasing need to efficiently consolidate Oracle applications on a platform that can result in the lowest TCO. At the same time, there has to be adequate planning to meet availability and scalability requirements. Consolidating Oracle applications on Linux is the right choice in most if not all environments. A brief introduction to some of the factors that impact consolidation of Oracle on Linux in a production, data center environment is outlined below. The focus of this paper is 9*i* database/application server and 11*i* Applications. But each topic also describes how Oracle 10*g* product features can dynamically provision computing resources to meet mission critical requirements.

Section 2 differentiates between server consolidation, resource consolidation, application consolidation, code consolidation and other types of consolidation. The focus of this paper is integrated code support across the entire infrastructure and application stack for Oracle on Linux deployments. The infrastructure stack consists of hardware, network, unbreakable Linux, cluster managers and cluster file systems. Section 3 covers planning for consolidation and discusses key success

metrics. Section 4 discusses the importance of different components in each layer of the infrastructure stack to be certified for different Oracle products namely 9*i*/10*g* database, *9i*/10*g* application server, 11*i* E-Business suite and Collaboration Suite. In this paper, the term *certified configuration* refers to a certified infrastructure and Oracle product stack. It is recommended that migration from Unix/Windows to Linux be executed in phases, with least mission critical applications first. Section 5 describes how to plan migration and consolidate deployments prior to rack and stack of x86 based servers with shared storage in a data center. Section 6 discusses rapid deployment of Oracle on Linux using imaging and cloning techniques. Imaging is an automated utility to load an OS and/or Oracle image on a certified server configuration. Cloning is a technique of copying the environment on one server to another or restoring an original zipped image from an archive onto a server or changing the identity of an existing server environment with a minimal number of changes. Section 7 discusses the operational matrix to manage different layers of the consolidated stack such as servers, storage, network, unbreakable Linux and Oracle products.

Consolidation of tens or hundreds of Oracle on Linux deployments requires structured change management procedures and utilities with the ultimate goal of improving serviceability. Software patch management and provisioning discussed in Section 8 are important processes in change management. Sizing and capacity planning utilities, discussed in Section 9, are important for resource optimization of hardware, software or operational staff. Scalability and availability to meet customer service level agreements is important in any production data center environment. These requirements need to be managed efficiently in an environment with tens or hundreds of x86 servers preferably using shared storage. Section 10 describes network and switch redundancy requirements, storage availability, clustered databases, clustered application servers and multi-node scalable E-Business deployments. Security best practices for network architecture and unbreakable Linux are discussed in Section 11.

2. WHAT DOES CONSOLIDATION MEAN?

Figure 1 shows the different layers of the infrastructure and Oracle product stack and integrated management approach for the entire stack. There are many types of consolidation and it is important to understand the differences in relation to the different elements of the stack.

Server Consolidation: also sometimes referred to as rack-and-stack consolidation, involves replacing existing servers with legacy operating systems (e.g. UNIX, VMS, MVS, etc) with smaller footprint x86 based servers running Linux or Windows. Horizontal (across nodes), vertical (across processors in a server) and cluster interconnect limits determine how Oracle products can scale and consolidate on the Linux platform. This type of consolidation is at the infrastructure level.

Oracle
11i E-Business Applications
Collaboration Suite 1.x/2.x

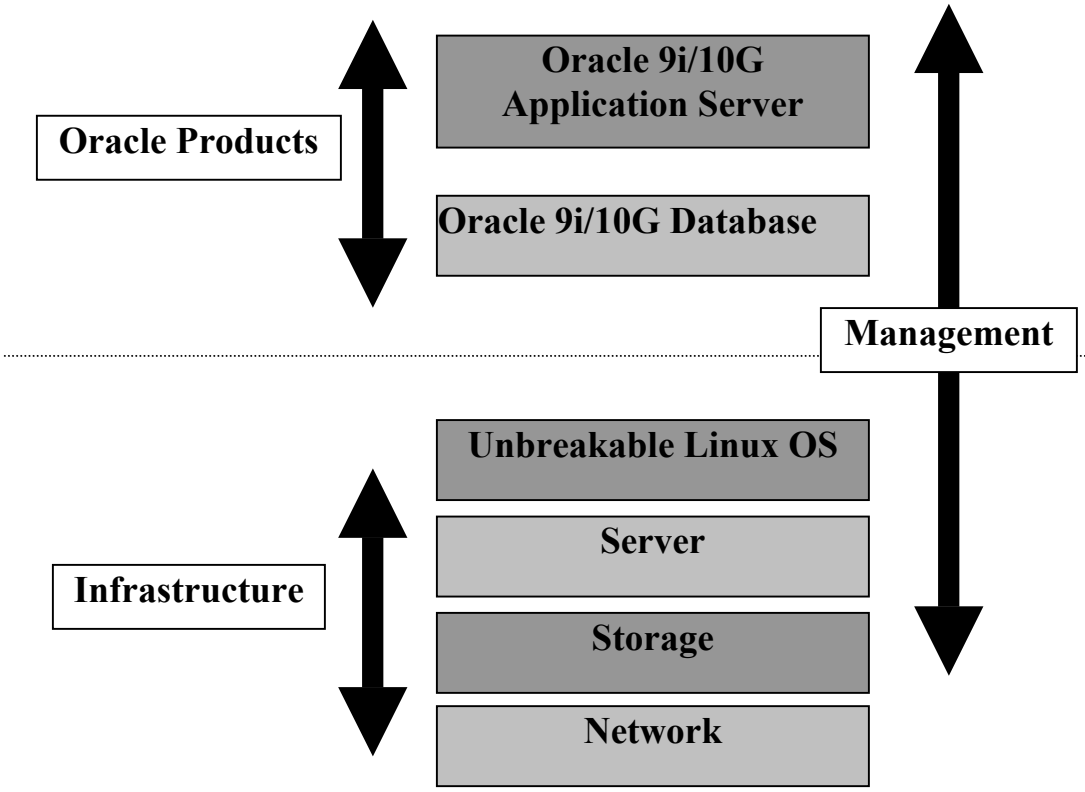

Figure 1: Oracle Deployment Stack

Application Consolidation: In the context of this paper, it refers to Oracle product and application optimization. It is also sometimes referred to as workload consolidation. Examples include reduction of database instances, increase in the number of applications accessing the same database by modifying data structures and consolidating ERP applications. The benefit is ease of management and reduction in operational staff. At the same time, the workload on each server may increase, necessitating the purchase of larger capacity servers. Scalability and availability must be adequately planned for so that the failure/security loopholes/peak demand in one application does not adversely impact the other applications.

Resource Consolidation: This is sometimes also referred to as resource optimization. It involves a combination of server, storage, operational staff and application consolidation. It is a strategy where the lowest total cost of ownership is key in determining the integrated result of consolidating servers, storage, network, operating systems, databases, applications and operational personnel for resource management.

Code Consolidation: Oracle supports the entire code stack from the unbreakable Linux level to the application level. This is a key differentiator between Oracle and

other enterprise software vendors for applications executing on non-proprietary, flexible and highly secure operating systems. Best practices outlined in this paper have a focus on code consolidation.

Other types of consolidation include:

Database Consolidation: Data from a variety of databases can be consolidated in a fewer number of databases to reduce redundancy and management overhead. The pros and cons of this type of consolidation are based on meeting application requirements such as service level agreements, peak load access patterns, etc.

System Management Consolidation: The goal is to minimize and consolidate the number of different management interfaces for server, storage, network, operating system and Oracle software. In reality, it is difficult to come up with a single vendor that offers an efficient end-to-end management solution. Best of breed management solutions such as the example (described later) in Table 1 can be used as a first step in system management consolidation.

Standards Consolidation: A collection of standards is used to implement the different types of consolidation listed above such as code consolidation, server consolidation, application consolidation, etc.

3. WHAT ARE THE SUCCESS METRICS?

It is important to define the goals of consolidation upfront in the lifecycle. Phased implementation can be evaluated at each milestone and incremental return on investment can be determined. Some of the questions helpful in defining consolidation goals are listed below along with examples of success metrics.

What are the critical/primary/secondary goals for consolidation? Examples include cost reduction, fewer errors, staff reduction, standardization, and service level improvement.

What is the importance of consolidation for the customer? Examples include C-level management sponsorship, financial budget commitment, and timeline for consolidation

What is the scope of consolidation? Examples include the different types of consolidation discussed in Section 2, enterprise wide or only specific lines of business and number/types of servers, storage, operating systems and Oracle instances involved.

What factors influence consolidation? Examples include establishing new or building on existing standards for hardware/software configurations, operational best practices, change management policies, security policies, application service level agreements and management of products in a best of breed environment versus a consolidated environment.

What are the impediments to success? Examples include using Linux as just another operating system rather than consolidating the majority of applications on

Linux. Current application requirements may not allow for consolidation on an enterprise basis in the short term because of commitments with vendors of proprietary hardware and operating systems.

What is the inventory of the current environment? This includes inventory of the entire technology and management stack with the type, number and version. Existing operational, change management, application service level agreements and security policies must also be clearly documented. This allows for analysis and report of findings.

4. CERTIFIED CONFIGURATION

A certified configuration is a stack of components that have been certified to work with an unbreakable Linux operating system kernel. Certification must be done at every layer of the stack as listed below. A minimum, best practices, certified configuration is a good starting point.

Hardware

Servers based on the x86 architecture must meet minimum specifications for Oracle applications to execute with good performance on the unbreakable Linux platform. The minimum specification could be 2 GB RAM and 2 CPU's per server. However, a typical two node RAC certified configuration could have a specification of 4G RAM, 4 CPU per server, 2 MB L2 cache and 4 network interface cards (NIC's) with 2 for the client, 1 for NAS storage and 1 for the cluster interconnect. Servers also need host bust adapter cards and NIC's to be certified for the Linux kernel. For more details on Oracle certified configurations from partners, visit www.dell.com or www.hp.com. Storage devices and associated fiber and network switches must also be certified. This includes direct attached (DAS), storage area network (SAN) and network-attached storage (NAS) devices. Components such as logical volume manager and other components using closed source drivers (e.g. EMC Power Path) must also be certified. For more information, visit www.emc.com or www.networkappliance.com.

Network

The network architecture is key for deployment of many Oracle instances on Linux. Copper cabling within the rack is acceptable. But fiber is recommended for SAN and NAS connections as well as for the network switch inputs. Network switch redundancy is recommended on a per rack basis. Load balancing routers and Big IP may be required for high volume, mid tier requests to meet performance requirements.

Unbreakable Linux OS

Oracle products are certified with specific versions (and above) of the unbreakable Linux kernel. The unbreakable, enterprise class, Linux kernel is distributed by Red Hat, SuSe, Turbo Linux or Connectiva. A kernel is deemed tainted if any third party

closed source drivers are loaded. The /sbin/lsmod command can be used to determine if the kernel is tainted or not. Oracle does not provide unbreakable support for tainted kernels. For more information on unbreakable Linux visit http://otn.oracle.com/linux. For information on Oracle product certification, visit www.metalink.oracle.com. Click on the Certify link.

Clusterware

Clusterware is crucial for Oracle Real Application Clusters (RAC) to function properly. Cluster Manager and cluster file systems are critical clusterware components. Use of Oracle's Cluster Manager is recommended, since third party cluster managers are not guaranteed under the Oracle unbreakable Linux support definition. Prior to installing clusterware components validate that the infrastructure stack is a certified configuration. Other helpful tips include using the latest certified kernel RPM, asynch IO, recommended OS patches for Oracle and Linux and the latest drivers from system vendors. Oracle's Clustered File System (OCFS) is a shared disk (shared SCSI or Fiber Channel) clustered file system. OCFS allows for easier management as it looks and feels like a regular file system. If using OCFS, download the latest release. If using raw volumes, pre-allocate extra raw volumes, limit the different sizes of the raw volumes to between 4 and 6 and do not embed tablespace name in device name. There is a 255 raw device limitation with Red Hat AS/ES 2.1 and United Linux 1.0. A workaround for this limitation can be found on www.metalink.oracle.com. For a large implementation like Oracle E-Business Suite, the preferred solution is OCFS. It is important to note that at this time OCFS only supports Redo Log files, Archive Log files, Control files, Oracle Data files, shared quorum disk file and shared init (srvconfig) file. General-purpose data files and RAC distribution binaries are not currently supported by OCFS. Minor kernel revisions do not need a rebuild of the OCFS module. Performance benchmarks have shown OCFS to be only a small percentage less efficient than raw partitions. For details on best practices for Oracle Cluster Manager, OCFS and raw partitions on Linux, refer to [1].

Oracle Products

It is important to differentiate between 9*i* database functionality and features included in the 10*g* database. This will help in making efficient choices of best practices. Oracle database products such as the 9*i* database and application servers are certified for a specific version of the Linux kernel and upward compatibility is normally the standard. Oracle 11*i* E-Business Suite is certified not only for a specific version of the Linux kernel but also for a specific version of the 9*i* database. Installation guides, cookbooks and best practice whitepapers for 9*i* RAC and 9*i*AS can be found on http://otn.oracle.com/linux for different flavors of unbreakable Linux executing on x86 architecture servers with different types of storage systems. Partners such as Dell and HP also have out-of-box, ready to deploy solutions for 9*i* RAC.

5. MIGRATION

The decision to migrate existing Oracle applications from Unix or Windows platforms to Linux may be for different reasons. Migration from Unix to Linux, in most cases, reduces infrastructure cost of ownership. Capacity can be provisioned on as needed basis rather than upfront in the deployment cycle. Migration from Windows to Linux is primarily based on security and proprietary OS considerations. In a Unix to Linux migration, existing servers are replaced but shared storage such as SAN or NAS devices can be reused. In a Windows to Linux migration, existing x86 servers and associated storage can be used provided they meet minimum, best practice specifications and components/drivers are upgraded accordingly. Clustering is the key technology to enable scaling on an as needed basis. Some of the key areas to consider prior to migration with the ultimate goal of efficient consolidation are described below.

- An assessment of existing infrastructure and applications to be migrated immediately and those to be transitioned long term should be performed [3]. Capacity planning helps in effectively consolidating servers, storage, racks, databases and applications. This eventually reduces space, power and air-conditioning overhead. It also allows for consolidated management of many x86 servers using shared storage.
- Setting migration project objectives and expectations goes a long way in ensuring a smooth migration and efficient consolidation. For example, if the application scales well on SMP, it is reasonable to expect it to scale on RAC. The application logic may not have to be changed to deploy successfully on RAC, but that does not eliminate the need to configure database connections or other parameters for availability and performance [1].
- Separate environments for development, testing and production are highly recommended in a Linux environment where stack alignment and certification is key.
- Stay current with Oracle product patches, OS patches and hardware driver upgrades. If the infrastructure and Oracle product stack are not aligned in terms of certification, substantial migration delays can occur.
- IT personnel should be trained in the areas of unbreakable Linux installation and management, Oracle on Linux installation and management, clustering and clustered file systems on Linux. Oracle Support does not provide enterprise class support for tainted kernels or closed source modules loaded into the kernel.
- Standardize on a certified hardware configuration and deployment model. This helps in the areas of rapid installation and provisioning as the numbers of deployments grow. For example, in some data centers, using a server with 2 CPU, 4GB RAM with 3 NIC's along with a network attached storage may be the most practical building block. Other data centers may

standardize on a 4 CPU, 8GB RAM, 2 NIC's and 2 HBA's if using a SAN configuration. The decision depends on many factors such as reuse of existing storage/servers, application load, growth rate and cost to name a few. Use the smallest acceptable footprint server that can meet the immediate requirements but is also ready for clustering, if scaling is required in the future. For storage, network attached devices are preferred for reasons of cost/deployment aggregated over several deployments and ease of file system management.

- Oracle database migration can be done using the export/import utility. E-Business Suite migration has been simplified with the release of the Oracle Platform Migration Utility. Java applications can be easily migrated by downloading the JDK for Linux on the server. Active Server Pages [ASP] applications can be migrated to Java using the Oracle 9*i*AS Migration Kit for ASP [1]. E-Business Suite applications can be migrated from a single instance database to a RAC database [8]. E-Business Suite applications can also migrated from a single node solution to a multi tier solution.

6. RAPID INSTALLATION

Rapid installation begins with a certified infrastructure configuration. Once a certified server/storage/switch combination has been decided, the steps listed below can be applied to clone that environment.

A. Execute a script to validate hardware meets minimum, certified configuration specifications.

B. Use kickstart or equivalent network OS download process to transfer the unbreakable Linux image onto the local disk of the server.

C. Execute a test script to validate correct installation of the unbreakable Linux.

D. Execute a configuration script to set up the parameters required to install Oracle on Linux.

Oracle Product Installation:

9*i* Single Instance Database

Oracle binaries can be loaded onto the server from CD's or the network to complete installation as listed in the documents on http://otn.oracle.com/linux

9*i* RAC Database

If using SAN, use the best practices listed in [9]. If using NAS, refer to the whitepaper in [10]. Oracle's Cluster Manager installation must be done using Oracle CD's prior to installing Oracle database binaries. Refer to documents [1] and [9] for best practices to install and configure Oracle Cluster Manager. If using OCFS, complete the installation prior to installing the Oracle database binaries. Refer to [1]

for best practices to install and configure OCFS. If the cluster has been installed and configured correctly, RAC installation should go smoothly. Refer to the RAC Quickstart installation guides on http://otn.oracle.com/linux for best practices on the specific flavor of unbreakable Linux (Red Hat AS/ES or United Linux) and specific platform (IA32, IA64). Using NFS mounts for ORACLE_HOME is not recommended due to single point of failure implications and also because node specific information for configuration is stored in ORACLE_HOME. For mass deployments of RAC, it is recommended to automate the above installation procedure.

9*i* Application Server

Configuration of the Oracle Linux user, installation of Oracle 9iAS and post installation configuration of Oracle 9iAS can be automated. Refer to [11] for the best practices and step-by-step instructions to install Oracle 9iAS 9.0.2 and above on Red Hat AS/ES 2.1. Oracle recommends two flexible, easy to implement, performing topologies for enterprise data center use. The first is for J2EE application deployment and the second is for Portal application deployment. The topologies enables use of commodity hardware, are secure, ensures good performance, is highly available in a 24*7 environment, uses minimal 3rd party products but is flexible to integrate other products if necessary [12]. The topology for J2EE applications consists of 4 tiers: Intranet, J2EE Business Logic DMZ, Web Tier DMZ and the Internet. There is a firewall interface between tiers. The Intranet tier houses the customer database. The J2EE Business Logic tier includes more than one J2EE application server and customer J2EE application. The Web tier houses Web Cache, OC4J, SSO, administration servers and load balancer equipment. Web browsers represent the Internet tier. For Portal applications, there are only 3 tiers with the J2EE Business Logic tier absent. Components such as Portal, Discoverer, Reports, Forms, Wireless and Web Cache are installed in the Web Tier and client components of Portal, Reports, Forms, Wireless and Discoverer also exist at the Internet tier.

11*i* E-Business Suite

The fastest way to deploy 11*i* E-Business Suite applications is to use an Oracle 9*i* database certified configuration for the backend. For example, to deploy Release 11.5.8 of E-Business Suite, use an Oracle 9.2.0.3 certified configuration. Oracle E-Business Suite consists of five tiers: admin, concurrent processing, forms, web and database. Each tier can be deployed on a separate server or all tiers can be combined on to a single server. Customer business requirements and service level agreements determine how many servers are deployed. As an example, assume a two node initial configuration with the database on one server and the rest of the E-Business Suite on the other server. The database server can be a standard, single instance database certified configuration described above. Application consolidation may require scaling at the backend database tier as well as other tiers of the E-Business Suite. Starting at the database tier, best practices are listed in [8]

to migrate from a single instance to RAC. Once the basic E-Business Suite on RAC environment is deployed successfully, it is possible to explore advanced features such as scaling Applications on multiple nodes with the database on RAC, setting up Parallel Concurrent Processing (PCP) for the purpose of failover and load balancing, Applications partitioning by responsibilities, Forms/Web load balancing and failover with Big-IP Load Balancer and environment cloning [13]. These advanced features are outside the scope of this paper because best practices for rapid installation will be different based on individual enterprise requirements.

Some Features in 10*g* Database

- Single CD installation for Oracle database.
- Multi node installation of RAC offers the option to choose between single, shared software image or a separate image for each host machine
- Linux clusterware is portable to other OS's. With a single install, clusterware can be installed on all identified nodes at once

Some Features in 10*g* Application Server

- Software cloning using a master node and Grid Control Repository (GCR) with centralized inventories for installation and configuration
- Archive and replicate specific configurations e.g. payroll configuration
- Context specific adjustments e.g. IP address, host name, web listener

7. OPERATIONAL MANAGEMENT

Operational management of Oracle on Linux enterprise deployments needs planning. Efficient consolidation is possible without a significant increase in cost of management; even though the quantity of rack mounted servers have increased. This is possible by virtualization of hardware and software resources. For deploying Oracle 9*i* products and 11*i* E-Business Suite applications, a combination of several different tools and utilities listed in Table 1 below are required to administer the system, OS, network and Oracle product [2]. Enterprise Manager 10*g* will have integrated features to deploy, upgrade, patch and manage the entire infrastructure and Oracle product stack. Refer to http://otn.oracle.com/linux for details on Enterprise Manager 10g.

Function	Red Hat 2.1 AS/ RHEL 3	Oracle 9*i* Products
Software Installation	Red Hat: Kick Start Dell: OpenManage Server Assistant	Oracle Universal Installer, Oracle Configuration Assistants
Software Patch	Red Hat Enterprise	Oracle Support

Management	Network Software Manager Dell: OpenManage Update Package	http://metalink.oracle.com Oracle Universal Installer
Software Distribution	Red Hat Enterprise Network Software Manager Dell: OpenManage Subscription Service	Oracle CD's, Downloads http://otn.oracle.com/linux
Backup and Recovery	HP: Data Protector	Recovery Manager
Server Management	Dell: OpenManage Server Administrator HP: Open View	N/A
Storage Management	Dell/EMC: OpenManage Array Manager, Navisphere HP: Open View Storage Manager	Oracle Clustered File System (OCFS)
Network Management	Red Hat Network Console, RedHat Enterprise Network Monitoring Module, Dell: OpenManage Network Manager	N/A
System Monitoring	Dell: OpenManage IT Assistant HP: Open View Operations, Open View Service Navigator	Oracle Enterprise Manager
System Tuning	Dell: OpenManage IT Assistant HP: Open View Performance Manager	Oracle Enterprise Manager Tuning and Diagnostics Packs, Statspack
System Troubleshooting	Netcrashdump	Oracle Enterprise Manager Diagnostics Pack
Oracle Instance Management	N/A	Oracle Enterprise Manager, GSD/srvctl

Table 1: Infrastructure and Oracle Product Stack Management

Red Hat has developed an automated installation method called kickstart to install Red Hat Linux on servers. A system administrator creates a single file containing answers to all questions normally asked during a typical installation. Kickstart files can then be copied onto a boot disk or made available on the network for individual servers to read. Future releases of Red Hat will allow for automated installation through the Red Hat network management interface.

Red Hat Enterprise Network (RHEN) comprises of two primary modules: Software Delivery Module and Monitoring Module. With the Red Hat Enterprise Network, a single system administrator can install and maintain hundreds or thousands of Red Hat Linux systems. The RHEN Software Manager offers Red Hat Package Manager updates on a subscription basis. The RHEN Network Monitoring module provides holistic monitoring of the entire infrastructure stack such as the OS, hardware and network tiers. It also provides end user monitoring such as URL and transaction monitoring. It is available as subscription software or as a hosted service.

Oracle Universal Installer and Oracle Configuration Assistants such as dbca and netca is cluster aware and used for installation and application of patch sets. Oracle Enterprise Manager is recommended for monitoring and administration of Oracle products on Linux

Some Features in 10*g* Database and Enterprise Manager 10*g*

- Automatic Storage Management (ASM) virtualizes storage and provides easy management and provisioning. A single ASM instance can manage storage for multiple Oracle database deployments. Many database files are mapped into disk groups, thereby allowing ASM to manage a smaller number of disk groups. Benefits include automated management of mirroring, striping and storage rebalancing thereby reducing cost of system and database administration.
- Resource Manager allows definition of resource plans and assignment of resource plans to job classes. Resource plans can be changed across time. For example, certain backup and data warehouse loading jobs can be marked as critical, but can only execute during non-peak hours.
- RAC management includes single system image monitoring and administration, RAC database management similar to single instance, and cluster aware jobs

Some Features in 10*g* Application Server

- Monitor virtual application resources e.g. J2EE containers, HTTP servers, Web Caches, firewalls, routers, software components
- Administer service level agreements

- Root cause diagnostics and real-time tracking of application availability, business transactions and end user performance
- Policy–based workload management

8.CHANGE MANAGEMENT AND SERVICEABILITY

Change Management is closely associated with serviceability and uptime/downtime. Provisioning is a mechanism to meet changing customer requirements on demand, in a reasonably short time, based on inventory available. Provisioning can be applied to hardware (servers, storage, switches), network, software and users. For example in software provisioning, if the software is in a central repository or on the network, different tools listed in Table 1 can be used to provision the OS or Oracle product software on demand. Software patch management must be done taking into account both the patch priority and frequency. Applying patches too frequently can cause disruption to production services. On the other hand, security and availability related patches must be applied at the first opportunity. For example, hardware can be provisioned by maintaining a small inventory of certified server configurations. The certified configurations are loaded and tested with Oracle on unbreakable Linux OS on the local disk drive. A MAC address and a mount point on network-attached storage (for customer data) are pre-allocated so that the server can be provisioned on demand in a matter of minutes instead of hours/days.

Some Features in 10*g* Database

- Change Management: Single button addition and removal of servers in a RAC cluster
- Network Provisioning: In an environment with multiple deployments of Oracle on Linux x86 architecture and the use of Infiniband technology, it is now easier to use a single network infrastructure for server to server and server to storage communication. As a result, a single network backplane can be used making network provisioning easier.

Some Features in 10*g* Application Server

- Grid Control Repository (GCR) with centralized inventories for installation and configuration can support automated provisioning of servers, software and users based on master node.
- Automation of upgrade and patching processes e.g. real-time discovery of new patches, rolling application upgrades and patch history tracking

9. SIZING AND CAPACITY PLANNING

Sizing and capacity planning are some of the first steps undertaken prior to consolidation of Oracle on Linux deployments. It is important to first characterize the workload and application requirements that are anticipated in the short term (6

months to a year). It is also helpful to understand the projected growth rate (3 to 5 years). Examples of workload characterization and application requirements include transaction rate/minute, transaction type, amount of data fetched in each transaction, expected maximum response time, number of concurrent users, etc. The output of sizing analysis and/or capacity planning describe the number and speed of the processors required, size of memory, number of servers if clustering is required at the database or application server level, size of the database, etc. High availability, scalability and backup/recovery requirements could further increase the capacity and number of components required. In most cases, consolidating applications sharing the same data is very efficient. In some cases however, security implications may necessitate some applications to reside on different physical servers.

In sizing a RAC database, it is important to document the maximum growth of nodes in the cluster. For example, assume the maximum number of nodes parameter was specified as 4 during the initial installation of a RAC cluster, even though the initial configuration consisted of only 2 nodes. Nodes can be added to the cluster until a maximum of four cluster nodes has been reached. If a fifth node must be added, a total cluster reconfiguration is necessary.

In sizing Portal or J2EE applications for consolidated enterprise deployment, the choice of topology discussed earlier, in addition to the application and workload characterization requirements will determine the capacity and number of servers.

In sizing E-Business Suite applications, the capacity of each server and the number of servers will be determined by a combination of the short term/long-term requirements and topology. The deployment topology could be a single node to house both 11i Applications and the database, if the growth rate is very small. A two-node topology (one for Applications and one for the database) may be appropriate for an environment where long-term requirements may not permit a single node configuration. A two-node topology also allows for scaling at both the backend database and the Application tiers. For example, if a fairly large E-Business Suite Application (about 2500 concurrent users) is being migrated from a Unix to Linux environment, a 2-node RAC cluster (4 CPU's with 16 GB of RAM) may be required for the backend database and up to 10 nodes (2 CPU's with 6 GB of RAM) required at the Application tier [7].

10. HIGH AVAILABILITY AND SCALABILITY

Consolidation of Oracle on Linux deployments must be planned taking into account the interaction between applications and the security and service level requirements of individual applications. For example, the failure of one application should not impact other mission critical applications. It is important to have high availability and scalability built in at every tier of the infrastructure and Oracle product stack when possible. Provisioning hardware and software will enhance availability and minimize downtime. High availability can be built in almost every tier of the stack but comes at an increase in cost. The cost is proportional to

meeting the customer service level agreements. Examples of high availability and scalability incorporated in enterprise data center environments include:

- Network: Dual 48 port, 10/100 or Gigabit network switches in each server rack with a provisioned network backbone
- Storage: RAID in Shared SCSI or Fiber Channel SAN devices; backup filer for storage recovery on Network Attached Storage devices
- Servers: Additional processors, RAM and network interface cards in each server for redundancy and accommodating peak load spikes
- OS: Unbreakable enterprise Linux kernel is always recommended over the SMP or single processor kernel for scalability in an enterprise deployment
- 9*i* RAC Database: Clustering facilitates high availability and scalability beyond what a single node solution offers
- 9*i* Application Server Clustering: Multiple application servers can be clustered using OC4J to improve availability and provide scalability for applications where user growth rates are unpredictable in advance
- 11*i* E-Business Suite Applications: Multi node deployments (starting from a two node topology) allows horizontal scaling, vertical scaling and failover capacity at every tier of the Applications stack

Some Features in 10*g* Database

- RAC automatically balances connections across the different instances hosting the same service.
- Resource Manager specifies policy for resource allocation to all services executed within a clustered database. This allows for better cluster utilization.
- Infiniband with its low latency and high-bandwidth, can be used for cluster interconnect in RAC thereby improving performance.

11. SECURITY

In any enterprise deployment, it is important to separate the development, test, user-acceptance testing and production environments. Even though in some cases, it would make sense to consolidate these environments, it is never good practice to locate these environments on the same physical box or even the same sub local area network for security reasons. Firewalls must separate these environments. Also as discussed earlier, firewalls should be used across tiers in a topology when deploying Portal, J2EE or E-Business Suite applications. Multiple levels of user security become even more relevant when using commodity servers in application server farms. Reduction of TCO by consolidation should be balanced against security requirements e.g. an entire server rack could be compromised if a single server is illegally intruded.

12. CONCLUSION

The benefits of consolidating several Oracle deployments on Linux x86 architectures have been discussed. The key factors for efficient consolidation are certified configurations and operational best practices. Using Linux as just another operating system in an enterprise data center does not guarantee a lower TCO. It is the efficient consolidation of multiple Oracle deployments balanced against high availability, scalability, security, operational management, and change management requirements that will in most cases reduce TCO.

RESOURCES

- Oracle on Linux: http://www.oracle.com/linux
- Oracle Technology Network Linux Center: http://otn.oracle.com/linux
- Oracle Technology Network Migration Center: http://otn.oracle.com/tech/migraton/content.html
- Oracle Support Online Metalink: http://metalink.oracle.com
- Oracle E-Business Suite on Linux: http://www.oracle.com/appsnet/technology/linux.html
- Oracle on Red Hat: http://www.redhat.oracle.com/solutions/partners/oracle

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