RED HAT® ENTERPRISE LINUX®

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WHITEPAPER

RED HAT ENTERPRISE LINUX 6 CONSOLIDATION

EXECUTIVE SUMMARY

At this time of massive and disruptive technological changes where applications must be nimbly deployed on physical, virtual, and cloud infrastructure, Red Hat Enterprise Linux provides businesses with the flexibility they need to thrive as they make the transition to the next generation of IT computing and beyond.

This paper examines consolidating multiple servers onto a single system using key technologies incorporated in Red Hat Enterprise Linux 6.

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INTRODUCTION

Your users are complaining about a slow web application – just install another dozen blades or 1U "pizza box" servers and the complaints go away. For now.

The use case for distributed processing using today's low-cost, high-performance, compact servers is compelling – a single server for a single task. A print server here. A file server there. A new application is needed, and the easiest way to deal with it is to run it on a dedicated server. There is a major upgrade to an existing application; you need to run the old version and the new version in parallel for a while. You have an old application that is important – perhaps even critical to your business. This application requires a specific version of an operating system, so you just leave it running on a dedicated server. Two engineering groups are arguing about their jobs running slow; just give them their own systems. Your users are complaining about a slow web application – just install another dozen blades or 1U "pizza box" servers and the complaints go away. For now.

Red Hat Enterprise Linux 6 is ideally suited to implementations using large numbers of small servers. It is powerful and flexible, supports a broad range of applications, and is easy to install and manage.

After all, what's the problem? A server is only a few hundred dollars, perhaps a few thousand dollars. They just plug into a regular wall outlet – no special power required. You can stuff a bunch of them in a rack, or put them out in departments. After all, you might as well take advantage of the new technology.

This works. With a strong master plan and solid implementation, it can be extremely effective and very cost-effective.

Or, with organic growth, little planning, and little coordination, it can become a resource-sapping nightmare.

Red Hat Enterprise Linux 6 is ideally suited to implementations using large numbers of small servers. Red Hat Enterprise Linux 6 is powerful and flexible, supports a broad range of applications, and is easy to install and manage. Many uses require nothing more than the native capabilities of Red Hat Enterprise Linux 6 – file, print, network management, web, database, CMS, and many other applications are distributed as part of Red Hat Enterprise Linux 6, and just need to be configured and started. Red Hat Enterprise Linux 6 has great distributed management capabilities, addressing much of the pain of distributed systems.

But you may determine that your servers are out of control – there are too many of them and each one is doing too little. It is common to discover that most of your distributed servers are running at 10-20 percent utilization levels, with a few greatly overloaded. You may also find that most of your distributed servers are not using more than 25 percent of their memory, but a few are out of memory and experiencing poor performance. Or, you may find that most of your servers have huge amounts of wasted storage, but a few critical systems are out of disk space.

Further, you are likely to find that each system has its own user accounts, and that you have no idea who has access to a given server, or what privileges they have on that system. All it takes is one little server in a forgotten corner with a user account for someone who left six months ago to open a security hole into your infrastructure.

Without really strong operational controls it is difficult to ensure that all systems are up to date, have current versions of your operating system and applications, and have the latest security patches installed.

One answer to this is server consolidation – to take the workloads of dozens of servers and run them on a few systems. Done properly, this can improve performance, increase user satisfaction, and reduce cost.

RED HAT ENTERPRISE LINUX 6 CONSOLIDATION

Red Hat Enterprise Linux 6 is also perfectly suited to consolidating many applications onto a single system.

The key elements to achieving this are:

- Support for large systems
  - Large CPU count
  - Large memory
  - Excellent I/O
- Control of resources
- Isolation of applications
- Support for heterogeneous software environments
- Reliability

Red Hat Enterprise Linux 6 has the ability to support:

- Over 4,000 processors
- 64TB of memory
- massive amounts of I/O
- large numbers of disk drives
- solid state storage

LARGE SYSTEMS

The first item to consider in consolidation is to make sure that a single system (or small number of systems) has sufficient performance to replace many dedicated servers. Red Hat Enterprise Linux 6 has excellent scalability. To summarize, Red Hat Enterprise Linux 6 has the ability to support over four thousand processors, 64TB of memory, and massive amounts of I/O.

Today, the systems used for consolidation are likely to include 24-128 processors (or cores) and 64GB to 1TB of memory. These systems are easily supported by Red Hat Enterprise Linux 6.

Red Hat Enterprise Linux 6 also supports excellent I/O and large storage. The default EXT4 file-system provides high performance and supports single filesystems up to 16TB. The optional XFS filesystem supports up to 100TB file systems. Red Hat Enterprise Linux 6 supports large numbers of disk drives, solid state storage (SSD), has native RAID, and has good storage management tools.

Red Hat Enterprise Linux 6 also has excellent network and networked storage capabilities. For networking, Red Hat Enterprise Linux 6 supports Gigabit Ethernet and 10GbE, as well as Infiniband. Networked storage capabilities include NFS V4 (and NFS V3), ISCSI, Fibre Channel, and FcoE (Fibre Channel over Ethernet).

When used with Fibre Channel, Red Hat Enterprise Linux 6 provides dynamic Multi-Path I/O (MPIO). MPIO allows the use of multiple Fibre Channel controllers in a single system. This can be used to increase I/O performance as well as allowing fail-over if a Fibre Channel link fails. Dynamic MPIO balances the I/O workload over the available I/O channels, delivering the best possible I/O performance with large SANs.

EXPENSIVE RESOURCES

Some hardware is very effective – but also very expensive. Examples of this include Storage Area Networks (SANs) and 10GbE. SANs are a very effective way to share data, provide access to large amounts of storage, provide high performance I/O, and to improve availability through redundant I/O paths.

However, SANs are also expensive. In addition to the storage controller cards that must be installed in the server – typically two cards for high availability – each storage controller requires a port on a Fibre Channel switch and a Fibre Channel cable. In some cases, Fibre Channel can cost more than the server itself. This is an ideal case to consolidate multiple servers into a single server and share expensive resources.

CONTROL OF RESOURCES WITH CGROUPS

RED HAT ENTERPRISE LINUX 6 GIVES YOU OPTIONS

Red Hat Enterprise Linux 6 process schedulers and memory management are designed to support large numbers of applications and ensure smooth operation.

A classic problem with putting multiple applications on a single server is the ability for one application to impact other applications. A single application with a memory leak can consume all memory in the system, starving other applications. An application can consume all available network or storage bandwidth, or can utilize all available CPU processing power. Preventing one application from impacting the performance of another is one of the main reasons for putting each application on its own server.

Red Hat Enterprise Linux 6 gives you options. First, the Red Hat Enterprise Linux 6 process schedulers and memory management are designed to support large numbers of applications and ensure smooth operation.

Beyond this, Red Hat Enterprise Linux 6 provides cgroups, a new capability for controlling the amount of resources an application can consume. For example, consider a server with 64 processors and 256 GB of memory supporting a workload that includes a large database, a file server, a web server, and a content management system, such as Drupal.

Using cgroups, the database, and its related database processes, can be given 32 CPUs, 192GB of memory, and 75 percent of the bandwidth of two Fibre Channel links into the SAN. Since caching is critical to database performance, eight specific CPUs (and related cache and memory) out of the available resources might be dedicated to the database server. The file server might be given four CPUs, 16GB of memory, 20 percent of the bandwidth of two Fibre Channel links, and 50 percent of network bandwidth. A dozen web servers would share16 GB of memory, 16 CPUs. And, as they have low storage I/O requirements, no specific limit on storage. Twenty Drupal sites might be given 20 CPUs and 20GB of memory.

In each case, the resources granted are the maximum that the application can consume. If the database workload is light, other applications could use the resources assigned to the database – Red Hat Enterprise Linux 6 does an excellent job of managing overall system resources and providing good performance for all applications.

HETEROGENEOUS SOFTWARE ENVIRONMENTS WITH VIRTUALIZATION

VIRTUALIZATION

Virtulaization using Kernel-based Virtual Machine (KVM) technology provides a complete virtual machine for each guest.

Virtualization using Kernel-based Virtual Machine (KVM) technology provides a complete virtual machine for each guest. A virtual machine is just that – it appears to be an actual hardware system to both operating systems and applications. Unlike Linux Containers, KVM virtual machines require the installation of a guest operating system. This operating system is completely independent from the host – using a Red Hat Enterprise Linux 6 host, you can run Red Hat Enterprise Linux 3, 4, 5, or 6, or Windows guests with full support.

Each guest is installed, managed, maintained, and updated independently. Completely different versions of software can be installed in each guest. The result is an ideal environment for server consolidation.

It is common to have specific versions of applications running; often older versions of applications. A company may actually have different versions of the same application, being used for different purposes. User environments may be extensively customized for specific uses. System names may be widely used for file servers and application servers. There are reasons for having multiple computers running different applications.

When using KVM technology, the full complement of operating system administrative features is available to manage and secure guest resources. System resources may be allocated per guest using cgroups. The administrator can assign different resources to a Windows guest running a client/server application than is assigned to a database on a Linux guest. Because the resources are explicitly allocated, resource contention and overhead are reduced and more guests may be supported.

With virtualization, all of these separate systems can be run on a single server. They maintain their own identity, but can share the physical resources of the large system. Using cgroups, the system resources are appropriately allocated. The result is better performance of the individual guests, better overall utilization of hardware, and reduced cost.

RELIABILITY

The final element of consolidation is reliability. One advantage of using multiple servers is avoiding a single point of failure. On the other hand, having multiple servers increases the probability that you will experience hardware failure – ten servers have ten times greater chance of having a failure (on one system) as a single server. So, multiple servers increase the probability of hardware failure, but minimize the scope and impact of a single failure.

A difference between high-and low-end servers is the level of RAS (Reliability, Availability, and Serviceability) features built into the system.

One of the differences between high-end servers and low-end servers is the level of RAS (Reliability, Availability, and Serviceability) features built into the system. Higher-end systems have additional RAS features and redundancy. At a simple level, for example, large servers are typically configured with multiple network and storage interfaces. They may also offer the ability to hot-swap peripherals and dynamically disable memory and CPUs.

Red Hat Enterprise Linux 6 supports a wide range of RAS features, including clustering and failover, as well as advanced diagnostic and logging capabilities that allow you to identify many types of failures before they occur and quickly identify which component failed so that you can repair a system and return it to service.

Further, Red Hat Enterprise Linux 6 provides the ability to live migrate running virtual machines from one server to another. This provides high availability in many ways. Routine maintenance of servers does not require shutting down vital applications – they can simply be moved to another server, and then migrated back after the work is completed. This process can be automated, based on factors such as server load or system log events.

Server load can be monitored, and a set of servers load balanced by live migrating busy applications to lightly loaded servers. The same tools can be used to monitor error logs. If hardware errors begin to show up, the applications on that server can be live migrated to other systems. A simple example of this could be a fan failure that caused a system to begin to overheat. It would be a few minutes between the time the fan failed and the system overheated to the point that it needed to be shutdown; this is plenty of time to live migrate running applications to other systems.

CONSOLIDATION

Red Hat Enterprise Linux 6 also provides the ideal platform for consolidating multiple systems onto a smaller number of servers.

CONCLUSION

Red Hat Enterprise Linux 6 provides the ideal platform for implementing distributed systems using the high-performance, low-cost servers that are available today. With proper planning, distributed systems can be effective, provide great performance, and excellent cost performance.

Red Hat Enterprise Linux 6 also provides the ideal platform for consolidating multiple systems onto a smaller number of servers. This can provide more effective utilization of computer resources, improve reliability and availability, be easier to manage, and be more cost-effective than a large number of lightly used small systems.

Finally, it is likely that the best solution will be a combination of large servers running large jobs (database servers are a classic example), dedicated servers running specific applications, consolidation servers running a collection of applications, and virtual machines that previously ran on lightly used (or obsolete) dedicated machines. Again, Red Hat Enterprise Linux 6 is the ideal platform for hosting the total environment.

IT departments that adopt Red Hat Enterprise Linux 6 will improve their agility, lower their costs, and reduce complexity with innovative technologies that span physical, virtual, and cloud infrastructures.

ABOUT RED HAT

Red Hat was founded in 1993 and is headquartered in Raleigh, NC. Today, with more than 60 offices around the world, Red Hat is the largest publicly traded technology company fully committed to open source. That commitment has paid off over time, for us and our customers, proving the value of open source software and establishing a viable business model built around the open source way.

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