OPTIMIZING SERVER UTILIZATION ON AIX

ADDRESSING HIGH AVAILABILITY AND DISASTER RECOVERY NEEDS IN AN AIX SERVER CONSOLIDATION ENVIRONMENT
TABLE OF CONTENTS

Executive Summary ...................................................................................................................................................4
Benefits of Server Consolidation ..........................................................................................................................4
  Optimizing Server Utilization With Partitioning ..................................................................................................4
High Availability and Server Consolidation ........................................................................................................4
  Local Clustering with VERITAS Server Cluster ..................................................................................................5
  VERITAS Cluster Server and Workload Management .......................................................................................5
Advantages of VERITAS Cluster Server .............................................................................................................5
Availability and Local Access to Data ..................................................................................................................6
  VERITAS Dynamic Multi-pathing .......................................................................................................................6
Leveraging Existing Technology for Metropolitan Disaster Recovery .................................................................6
Extending Local Clustering For True Disaster Tolerant Solutions ....................................................................6
  Global Application Availability with VERITAS Global Cluster Manager .........................................................6
  Data Replication with VERITAS Volume Replicator .........................................................................................7
Cluster Management Benefits ............................................................................................................................7
The VERITAS Advantage for Server Consolidation ...........................................................................................8
Server Consolidation Scenarios ...........................................................................................................................9
Conclusion ................................................................................................................................................................12

Copyright © 2003 VERITAS Software Corporation. All rights reserved. VERITAS, the VERITAS Logo and all other VERITAS product names and slogans are trademarks or registered trademarks of VERITAS Software Corporation. VERITAS, the VERITAS Logo Reg. U.S. Pat. & Tm. Off. Other product names and/or slogans mentioned herein may be trademarks or registered trademarks of their respective companies. Specifications and product offerings subject to change without notice.
TABLE OF FIGURES

Figure 1: GCM Summary Tab View .......................................................... 8
Figure 2: Migration from Multiple Clusters to one Cluster .......................... 9
Figure 3: Migration from Physical to Virtual Servers ................................ 10
Figure 4: VCS Stretch Cluster with VM Mirroring ..................................... 11
Figure 5: Architecture for Consolidating Clusters ..................................... 12
EXECUTIVE SUMMARY

System administrators are continually challenged to simplify the management of and reduce the complexity of distributed data center environments in order to drive down costs. The ultimate goal is to be able to deliver the service levels that their customers demand with the same or fewer resources. One solution to this challenge that many administrators have identified is to replace older, slower servers with fewer, more powerful ones – otherwise known as “server consolidation.”

For those considering consolidating multiple server workloads onto a smaller number of IBM servers, or even a single server, running AIX, this paper will outline the benefits of migrating your applications in conjunction with VERITAS storage management, high availability, and disaster recovery solutions within an AIX environment.

BENEFITS OF SERVER CONSOLIDATION

Many studies conducted by industry analysts and vendors have confirmed the myriad benefits of server consolidation. They include:

- Simplification of IT environment
- Centralization and automation of procedures
- Lower total cost of ownership (TCO); that is the labor costs of administration, back-up, and operations management decreases
- Costs for distribution, management, and update of software are reduced
- Newer servers are faster, partition-enabled, and cheaper to maintain than the older, distributed servers being replaced
- Automatically moving workloads between dynamic logical partitions enables users to reap the benefits of initial promises of on-demand, utility computing

OPTIMIZING SERVER UTILIZATION WITH PARTITIONING

One of the key objectives for server consolidation is to optimize server utilization. Industry studies have shown that UNIX servers are only 15% utilized as far as computing and I/O resources. Mainframe vendors, on the other hand, have promoted utilization numbers as high as 85%. By using virtualization techniques on pSeries servers, administrators can improve their servers’ utilization rates and perhaps even approach those delivered by mainframes.

To facilitate the consolidation of many separate systems and or applications onto fewer server systems, the IBM pSeries servers support logical partitions (LPARs). Partitioning enables multiple operating system images to run on a single server. As a result, this technology allows multiple physical servers and or clusters of servers to be migrated onto a single AIX server, comprised of multiple LPARs. This reduces the number of servers in the data center environment. With AIX 5.2, dynamic logical partitioning is supported. Processors, memory, and I/O channels can be shifted automatically with scripts from one partition to another to satisfy workload, without necessarily having to reboot the partition or to restart applications. This is part of the promise of utility, “on-demand” computing, popular throughout the computing industry today. The p690, for instance, supports 32-way processing, and each LPAR can be partitioned anywhere from a single CPU to 32 CPUs. Workloads from each smaller, distributed server can be transferred directly to a corresponding LPAR.

HIGH AVAILABILITY AND SERVER CONSOLIDATION

Given that the IT services are being consolidated to fewer servers and the increased competitive pressures to maintain service level goals, there is a heightened urgency to deliver high availability (HA). Server consolidation without a high availability plan could be a recipe for disaster.
LOCAL CLUSTERING WITH VERITAS SERVER CLUSTER

At the fundamental level, clustering\(^1\) the application services within a single data center helps to ensure application availability to the end users. The cornerstone of high availability, VERITAS Cluster Server (VCS) is the industry’s leading open systems clustering solution\(^2\). VERITAS Cluster Server helps to eliminate both planned and unplanned application downtime, facilitate server consolidation, and efficiently manage a wide range of applications in heterogeneous environments. With support for up to clustered 32 nodes or partitions in storage area network (SAN) and client/server environments, VERITAS Cluster Server allows the IT staff to scale for horizontal growth. VCS also features the power and flexibility to protect everything from a single critical database instance, to very large multi-application clusters in networked storage environments.

With IBM’s pSeries, administrators can protect their consolidated workload by clustering the LPARs together within a server. If a fault should occur within the partition, be it software or hardware, VCS can automatically move application services from one partition to another within the same physical server, or on a different physical server if necessary. Simultaneously, IBM’s dynamic LPAR can modulate the workloads by moving CPUs or memory from one partition to another – in effect, from an application not requiring the compute cycles to an application needing more. This switch can occur without bringing the cluster down or causing downtime to any application. VCS supports this “dynamic reconfiguration” of pSeries servers.

VERITAS Cluster Server and Workload Management

In addition to IBM servers’ ability to re-allocate server resources dynamically, VCS incorporates its own intelligent workload management. VCS can distribute workloads to whichever cluster node has the most available capacity. Users can assign a capacity value to each node within the cluster, based on computing parameters like number of CPUs, CPU speed, memory, etc. A load value is then designated for each application or database under VCS control. If an application or database needs to migrate to another node in order to continue to provide service, VCS will pick the node with the highest capacity to which that application will move. The same methodology would apply if a server were to panic. Application services would be relocated. Once re-distributed, server capacities are recalculated based on their new loads. The end result is that idle hardware does not need to be maintained as spares to recover failed applications, thus facilitating hardware efficiency and high availability for the server consolidation project.

ADVANTAGES OF VERITAS CLUSTER SERVER

As a high availability clustering software solution, VERITAS Cluster Server has some advantages over the competitive products in the marketplace. Some important differences deserve to be highlighted:

- **Heterogeneity**: Data centers typically consist of servers with several types of UNIX (AIX, HP-UX, Red Hat Linux, and Solaris) and various versions of Windows (NT, 2000). VCS supports all these platforms and offers the same look and feel across the operating systems. Deploying the same clustering technology on multiple platforms minimizes the training needed for IT staff to install, configure, and manage clusters across the enterprise. The IT staff can instead focus on other value-added services, such as pre-production testing. VCS’ heterogeneity also means an easier transition for the IT staff as they migrate their older distributed platforms to IBM AIX.

- **Ease of Deployment and Use**: VERITAS Cluster Server ships with both a web-based GUI and Java-based GUI. For UNIX administrators a command line interface is also available. The product also integrates Wizards into the product to guide you through complex database configurations and product configuration. This results in faster deployment of and faster return on investment on the data center resources. The VCS GUI also allows monitoring of an entire enterprise’s clusters. From a single VCS console, administrators can monitor real-time status of all their VCS clusters simultaneously, regardless of operating system.

- **Disaster Recovery Support**: VERITAS Cluster Server integrates with Global Cluster Manager to provide seamless high availability and disaster recovery. One key advantage of the VERITAS DR solution is the

---

\(^1\) Clustering is the grouping of servers or partitions having sufficient redundancy of software and hardware components such that a failure will not disrupt the availability of the application services.

\(^2\) IDC 2001
broad support of third-party replication products. This allows customers to standardize on industry leading solutions, such as VERITAS Volume Replicator and EMC SRDF.

- **Application Support:** VERITAS Cluster Server ships with off-the-shelf agent support for the leading databases and enterprise applications, including DB2, Oracle, PeopleSoft, SAP, Siebel, and VERITAS NetBackup. In addition, an agent framework is provided for custom agent development.

**AVAILABILITY AND LOCAL ACCESS TO DATA**

While clustering plays a key role in local application availability, access to data represents another aspect to the overall availability of the IT services. Effective storage management and virtualization compliment endeavors to deliver on service level goals. One method of ensuring data availability with virtualization technology is with multi-pathing software. This is software to ensure continuous data access between servers and storage. In effect, multi-pathing technology improves the throughput performance and eliminates single points of failure.

AIX customers commonly choose from the following multi-pathing software, usually delivered from storage vendors:
- EMC PowerPath
- IBM Subsystem Device Driver
- VERITAS Dynamic Multi-pathing (DMP)

**VERITAS Dynamic Multi-pathing**

Within the multi-pathing software space, VERITAS offers a clear advantage – it is storage vendor independent. This means that VERITAS DMP will support storage arrays and devices from multiple vendors. Since VERITAS DMP is delivered with the VERITAS Volume Manager, the VERITAS Foundation Suite, and all versions of VERITAS Database Edition, customers can use VERITAS DMP without paying an extra charge. VERITAS DMP increases performance by spreading I/O traffic amongst an unlimited number of paths between servers and storage. These paths can “take-over” for each other should any path fault and operate in a number of infrastructure configurations: e.g., fibre channel arbitrated loop, switch fabric, and SCSI.

**LEVERAGING EXISTING TECHNOLOGY FOR METROPOLITAN DISASTER RECOVERY**

VERITAS provides a smooth transition from high availability for single data centers to disaster recovery for metropolitan-wide, distributed data centers. Combining VCS with the remote mirroring capabilities of VERITAS Volume Manager (over a fiber-channel SAN) has been the proven solution of choice by many of the leading financial institutions on Wall Street. This architecture, known as a stretch cluster or a metropolitan area network (MAN) cluster, provides disaster recovery against localized disasters (e.g., fires, tornados, earthquakes, and terrorist attacks) over a limited distance that generally does not exceed 100 kilometers. This level of geographic separation is particularly effective in densely populated areas like large financial districts in downtown cities. Part of the planning for server consolidation should consider strategies that incorporate high availability and disaster recovery. The value of VERITAS solutions is that a business can take its existing VERITAS cluster and stretch it to accommodate DR requirements without making additional and often substantial investments.

**EXTENDING LOCAL CLUSTERING FOR TRUE DISASTER TOLERANT SOLUTIONS**

For the ultimate in disaster recovery for the consolidated servers, customers can combine wide-area data replication with global application failover. VERITAS provides a single, web-based console to manage your high availability and disaster recovery architectures for both VCS clusters and wide-area replication, across all major operating system platforms. Integrated, configurable events and policies allow coordinated application-level, cluster-level, or site-level takeover or migration through a single click of a button. This proven solution can reduce the downtime of application services from days and hours to minutes. In fact, VERITAS’ wide-area disaster recovery architecture is the recommend solution by IBM Global Services for open systems environments.

**Global Application Availability with VERITAS Global Cluster Manager**

VERITAS Global Cluster Manager (GCM) allows administrators to monitor and manage from a single, web-based console their clustered services running around the world. Since GCM builds upon the VERITAS Cluster Server technology, data centers are protected against failures locally with VCS. Customers can integrate Global Cluster

Copyright © 2003 VERITAS Software Corporation. All rights reserved. VERITAS, the VERITAS Logo and all other VERITAS product names and slogans are trademarks or registered trademarks of VERITAS Software Corporation. VERITAS, the VERITAS Logo Reg. U.S. Pat. & Tm. Off. Other product names and/or slogans mentioned herein may be trademarks or registered trademarks of their respective companies. Specifications and product offerings subject to change without notice.
Manager into their VCS environments with ease. Once implemented, administrators can fail over application and replication services with a single click of a button. End users can be automatically re-directed to the remote site for seamless service. For data access, GCM integrated with the leading data replication products, including host-based replication such as VERITAS Volume Replicator (discussed next) and hardware-based replication such as EMC SRDF. Having a one-button site migration facilitates a consistent and secure method for maintaining availability in the event of a site disaster. After all, in the event of a true disaster, administrators can focus on the business-level processes surrounding disaster recovery, rather than worry about the details of which command line to input in order to fail over applications to a remote site.

Data Replication with VERITAS Volume Replicator

VERITAS Volume Replicator (VVR) is a highly scalable and flexible solution for managing on-going data replication to one or more sites with guaranteed data integrity. VERITAS Volume Replicator is an option to VERITAS Volume Manager and replicates data at the logical volume level, thereby eliminating the need to use the exact same storage at the primary and secondary locations. Organizations can replicate data between any of the same vendor’s storage arrays or between different vendors’ storage arrays. Volume Replicator replicates only the changed blocks to the secondary site, thereby controlling the network bandwidth requirements (and thus cost) of this solution. Whenever data is written to the original volume, VERITAS Volume Replicator automatically sends that same set of data to the replicated sites.

VERITAS Volume Replicator provides both synchronous and asynchronous replication. If an organization needs zero data loss, it would use synchronous replication. Conversely, if an organization needs minimal application performance impact, it would use asynchronous replication. With synchronous replication, the initial write is not committed until the data has been replicated successfully at the remote site. This ensures that there will be zero data loss between the primary and secondary locations. However, the application is waiting for the network round trip. As a result, the farther the distance, the more application performance impact the environment will have to incur. With asynchronous replication, the write request at the primary site is committed to disk immediately. As soon as the network can afford to take the request, typically within milliseconds, the data is sent to the secondary site. Asynchronous replication has minimal data loss impact between the primary and secondary locations, but there is no application performance impact. VERITAS Volume Replicator adds an additional option, a soft-synchronous mode, whereby replication is set to synchronous mode under normal circumstances, but automatically converts to asynchronous mode in the case of a temporary network outage. Therefore, organizations are protected against network outages while using replication. In all cases, replication guarantees write-order fidelity between the primary and secondary replication sites. There are no distance limitations, and VVR can be managed through the CLI, GUI, or through VERITAS Global Cluster Manager. VERITAS Volume Replicator supports a variety of replication configurations (e.g., one-to-one, one-to-many, and many-to-one), and up to 32 total sites. In addition, VVR can replicate data between Solaris and AIX operating systems to be used for site migration and server consolidation.

Cluster Management Benefits

As a recap, Global Cluster Manager (GCM) allows monitoring of clusters of any operating system (OS), on a console running any OS. Not only can GCM facilitate server consolidation by migrating application services from smaller, distributed servers onto larger AIX servers, it provides a centralized, world-wide view into the availability status of all clusters within an enterprise, wherever they might be located. The following screen shot provides a good example of how clusters and application services can be presented intuitively.
As briefly mentioned before, many customers migrating to IBM AIX can leverage VERITAS strong cross-platform commitment. VERITAS can help ease this AIX transition because VERITAS software runs across multiple operating systems. The same ease-of-use that system administrators enjoy with products like VERITAS Volume Manager, File System, Cluster Server, Volume Replicator, Global Cluster Manager, and NetBackup is available in identical versions on AIX. In fact, VERITAS uses the same code base across all of its UNIX versions (AIX, HP-UX, Linux, and Solaris). This lowers training cost, since system administrators are already familiar with the migrated AIX versions.

Another advantage with VERITAS solutions is that the products portfolio is tested and integrated. This means interoperability of the products within your environment to deliver a single solution that addresses the customer’s specific needs. Additionally, the VERITAS solutions are modular. This means that the customer can decide upon the level of investment needed to achieve the initial business goals. In this way, the IT department can help manage costs. As that same customer’s business needs evolve, the IT department can build upon what they already have. This translates into investment protection. VERITAS Software allows customers to “build as they go.”
SERVER CONSOLIDATION SCENARIOS

The following select scenarios help demonstrate how VERITAS HA/DR products can be used in some typical server consolidation projects.

Scenario 1
- Mixed platform environment
- Mixed storage environment
- Mission critical databases and applications

Figure 2: Migration from Multiple Clusters to One Cluster

This picture shows consolidation of two VCS clusters, both Solaris and AIX, as well as two stand-alone servers, being consolidated into a single VCS cluster on AIX (going from left to right). Note that the use of multiple storage vendors has been maintained from the multiple to the single cluster scenario. Since VERITAS Volume Replicator (VVR) supports replication between AIX and Solaris platforms, the data can be migrated from each cluster or server using VVR. Note that Global Cluster Manager (GCM) could be used to migrate applications, like DB2, from the multiple-cluster “site” or “sites” over to the single VCS cluster (two single node clusters, and two 2-node clusters).

It should be noted as well that fewer application licenses would then be needed on the consolidated site, due to fewer servers running the applications. The end result is raised service levels, simplified management, and lowered costs.
Figure 3: Migration from Physical to Virtual Servers

In the migration shown above, three physical nodes of a VCS cluster are migrated to three virtual nodes (logical partitions) on a single p690. The LPARs are clustered with VCS. Again, VVR and GCM are used to accomplish the data and application migrations. VCS and GCM recognize LPARs as nodes of the cluster, so migration can proceed from physical server directly to virtual partition. Failover from one LPAR to another is accomplished with VCS.

This is an excellent example of a pure server consolidation: three servers have become one. A possible downside impact is that a new single point of failure (SPOF) is created, namely, the single p690 itself. But VCS can mitigate the risk here. If one LPAR were to fault – similar to a physical server fault – application workload could be migrated from the faulted LPAR over to one of the functioning LPARs.

So let's say that you've managed to accomplish a degree of server consolidation, and you've even put in place high availability components. Now the CIO comes into your office and asks to see the disaster recovery plan. The good news is that if you've used VCS and VM to secure your high availability, you already have the ingredients for a robust disaster recovery configuration: a stretch cluster, also called Metropolitan Area Network (MAN) cluster. The following diagram shows how nodes and storage within the cluster can be geographically separated into two sites. Volume Manager, together with VERITAS FlashSnap and Fast Mirror Resynch (FMR), mirrors the data in a two-phase commit methodology to each site. This is equivalent to synchronous replication between sites in that there is no data latency. The following diagram shows the basic architecture used by a customer implementing a stretch cluster on AIX.
Norwich Union has deployed a stretch cluster on AIX (under 100 kilometers). Their enterprise consists of:

- 2 Data Centers
- 100’s of servers (Several p690s)
- AIX (in addition to Sun, HP-UX, Windows)
- Dozens of clusters
- Oracle database
- VERITAS Volume Manager mirrors data between sites
- VERITAS Cluster Server keeps applications highly available

Figure 4: VCS Stretch Cluster with VM Mirroring
Here’s an example of how you can save money with VCS to accomplish the server consolidation. On the left is an organization with 6 clusters and 12 servers, housing database as well as file and print servers. By using workload management, we can have standby capacity instead of standby servers. Through server consolidation, we now have one cluster with 9 servers. Seven of those servers are in use, and the last two are ready with extra capacity should you need it – the so-called “n to n” cluster configuration and in this case, 7 to 2. Using VCS’ Service Group Workload Management feature, the application can select the cluster node that is least loaded, and therefore most able, to host that application. By consolidating all the servers into one cluster, management becomes a lot easier, and you save money by not having idle servers in your data center.

If we look at the example in terms of dollars and cents, we can estimate the server cost savings from this consolidation project. If we place an average value of $10,000 on each server, and imagine that we had 50 sites with clusters. If we further assume the same savings of 3 servers per site from consolidation (from 12 to 9 servers), overall cost reduction would be $1,500,000 (50 X 3 X $10,000), which excludes operational costs.

CONCLUSION

Server consolidation will save money, but the software and hardware infrastructure must be adjusted appropriately to ensure reliability. VERITAS high availability, storage foundation, and disaster recovery solutions help secure such savings by providing the needed high availability and management services that a consolidated IT environment demands. And as shown, since VERITAS products are heterogeneous, they can facilitate in the migration of both data and applications from non-AIX platforms to AIX high-end servers.