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VERITAS Cluster Server

Enterprise Availability Management

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Introduction

Several major trends are affecting the evolution of enterprise computing architectures. Shrinking budgets and the complexities associated with distributed management are encouraging a re-centralization of critical resources, including servers, storage and management personnel. The availability of ever larger servers (or nodes) and favorable cost factors, particularly in the purchase of storage hardware, are helping to make re-centralization economically feasible. Coupled with the normal growth of storage in a healthy business environment, this consolidation has resulted in an explosive growth of storage capacity that must be managed. This has put new demands on storage management vendors to provide better technologies to share and manage large centralized data stores. As MIS shops evolve to accommodate and leverage these trends, end users continue to clamor for high speed, ubiquitous access to applications and data.

High availability configurations that offer fully automated fault management have become a mainstream technology in the distributed model. Due to the increasing criticality of enterprise data, proactive availability management is becoming a necessity for more and more applications. Re-centralization offers opportunities to improve overall availability management while potentially reducing costs. New architectures, such as storage area networking (SAN), are emerging to supplement existing architectures, offering more choices to improve performance, availability and manageability. Architecture-neutral availability management products must evolve as well to leverage these new architectures, as well as providing the scalability necessary to accommodate the increased size of centralized resource pools. In a more centralized model, availability management products that focus on protecting logically defined application services rather than physical systems will offer a more flexible, more cost-effective approach.

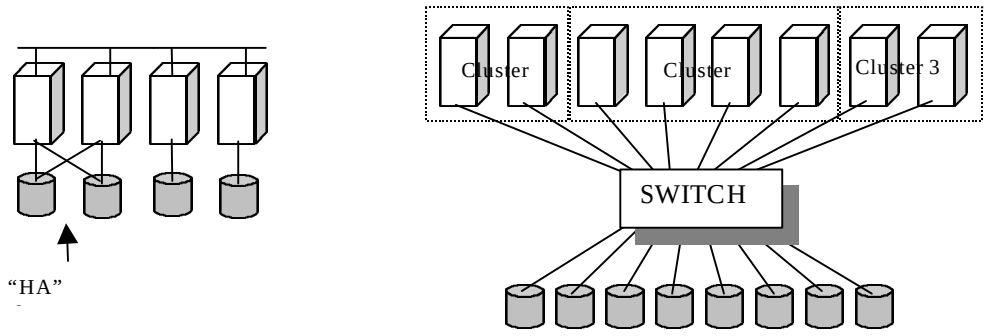

Figure 1. A comparison of the traditional "distributed" data architecture, with a set of shared disk cross coupled between two nodes, with the emerging SAN architecture that supports high speed direct access from any node to any disk.

Storage area networks, in particular, are designed to replace today's "point to point" (client *x* accesses node *y* to get to disk *z*) access methods with a new "any to any" architecture. In the traditional model, if disks are logically shared, this sharing occurs at LAN speeds (100 Mbit/sec) or is limited to the small number of nodes which can be directly attached to a given disk array (usually no more than four). Through the addition of a high-speed switch, clients can access any disk from any node on the SAN at channel speeds (100MB/sec). This allows a much larger number of nodes much faster access to a much larger centralized data store.

Redundancy is easily added to a SAN through the incorporation of a second switch or redundant switching components to support high availability data access. Additional nodes and disk arrays can be easily added to these configurations with minimal disruption by plugging new components into the switch, providing a much simpler and more scalable growth path than traditional architectures. Finally, multi-node SAN-based clusters offer a much more cost-effective and flexible approach for proactively managing availability at the application level: any node in the SAN may potentially back up any other node. One or two dedicated nodes can now backup a much greater number of nodes, thereby significantly reducing the hardware costs associated with cluster configurations.

Heterogeneity is a reality in today's enterprise environments. Cost-effective management tools, whether they focus on performance, availability, or some other metric, must offer a wide range of cross platform support. This cross platform support should include various operating system environments, hardware platforms, disk and tape manufacturers and application and interconnect vendors. Products limited to supporting only the equipment of a single vendor will always offer a more expensive and fragmented approach to managing the realities of today's heterogeneous environments.

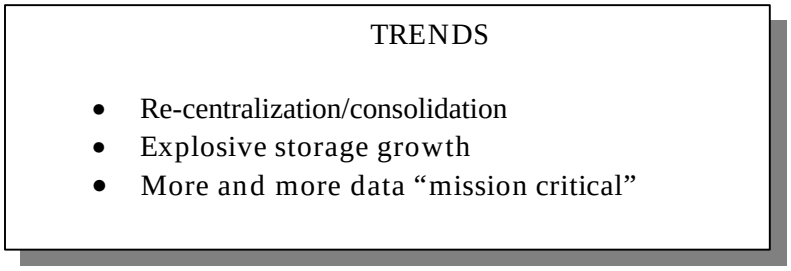

Figure 2. Trends driving the emergence of SAN.

Management Needs For the Emerging Storage Architectures

Traditional availability management tools can manage two node clusters reasonably well but are not well suited to manage clusters with more than four nodes. Before the multi-node configurations enabled by SANs can be efficiently leveraged in mainstream enterprise computing, SAN-aware cluster management software must also be available. The appropriate availability management tool will allow various resources, such as physical disks, application services and network connections, to be treated as logical resources. Within the larger, more flexible SAN environments, logical associations between resources can be used to assemble, migrate, recover and manage an application service quickly, easily and in a manner completely transparent to end users. The availability management tool interface should allow for easy access from any platform, offer both a GUI and a command line interface and provide a single point of management for the entire SAN configuration, regardless of the number of clusters.

Basic Concepts in VERITAS Availability Management

Earlier it was mentioned that to fully leverage larger cluster configurations, an availability management tool needed to focus on proactively managing *application services* rather than nodes. As nodes get larger, it is less likely that they will be used to host a single application service. Particularly on the larger Sun servers such as the E6000 or the E10000, it is rare that the entire server will be dedicated to a single application service. Failures that affect a single application service, such as a software failure or hang, should not necessarily affect other application services that may reside on the same physical host. If they do, then downtime may be unnecessarily incurred for the other application services.

What Is an Application Service?

An application service is the service the end user perceives when accessing a particular network address. An application service is typically composed of multiple resources, some hardware and some software based, all cooperating together to produce a single service. For example, a database service may be composed of one or more logical network addresses (such as IP), RDBMS software, an underlying file system, a logical volume manager and a set of physical disks being managed by the volume manager. If this service, typically called a *service group*, needed to be migrated to another node for recovery purposes, all of its resources must migrate together to re-create the service on another node. A single large node may host any number of service groups, each providing a discrete service to networked clients who may or may not know that they physically reside on a single node.

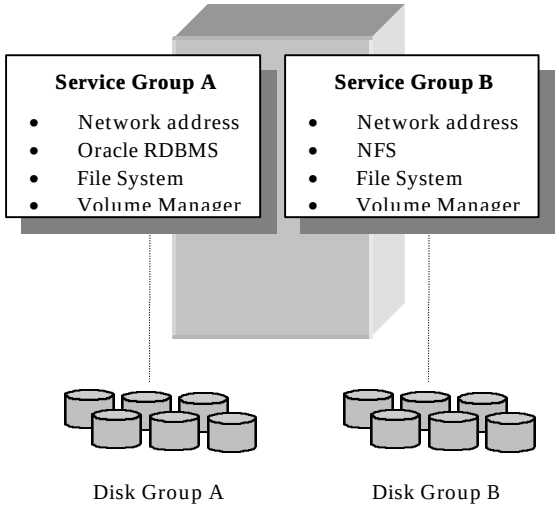

Figure 3. A node hosting two distinct service groups.

Service groups can be proactively managed to maintain service availability through an intelligent availability management tool. Given the ability to test a service group to ensure that it is providing the expected service to networked clients and an ability to automatically start and stop it, such a service group can be made highly available. If multiple service groups are running on a single node, then they must be monitored and managed independently. Independent management allows

a service group to be automatically recovered or manually idled (e.g. for administrative or maintenance reasons) without necessarily impacting any of the other service groups running on a node. This is particularly important on the larger Sun nodes such as the E6000 and the E10000, which may easily be running eight or more applications concurrently. Of course, if the entire server crashes (as opposed to just a software failure or hang), then all the service groups on that node must be recovered elsewhere.

At the most basic level, the fault management process includes monitoring a service group and, when a failure is detected, restarting that service group automatically. This could mean restarting it locally or moving it to another node and then restarting it, as determined by the type of failure incurred. In the case of local restart in response to a fault, the entire service group does not necessarily need to be restarted; perhaps just a single resource within that group may need to be restarted to restore the application service. An agent typically monitors application services, which is a small, application-specific fault management program. Given that service groups can be independently manipulated, a failed node's workload can be load balanced across remaining cluster nodes, and potentially failed over successive times (due to consecutive failures over time) without manual intervention, as shown below.

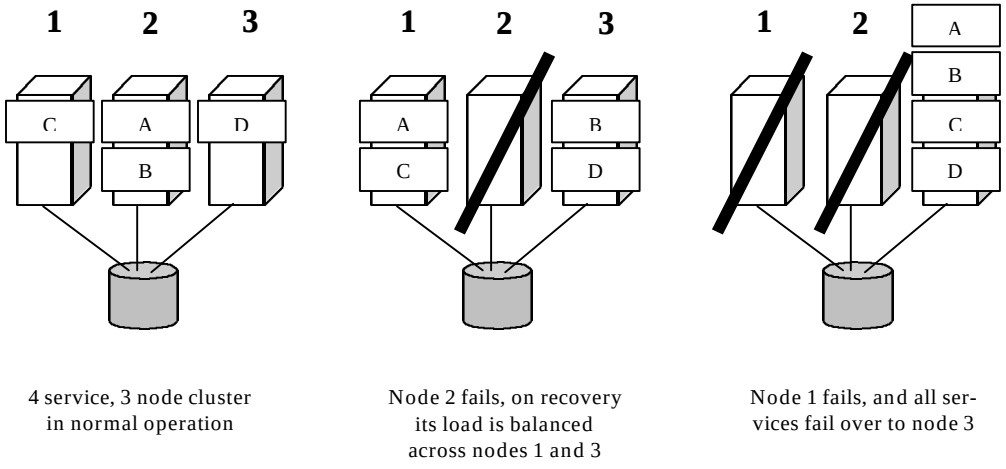

Figure 4. Automated recovery from multiple successive failures, demonstrating dynamic load balancing on failover and "cascading" failover, in a simple three node, shared disk cluster.

Managing Planned and Unplanned Downtime

Application service availability should be measured from a networked client's point of view. If an application service is unavailable, it does not make much difference to the client that some downtime is planned due to required administrative and maintenance tasks while other downtime is unplanned, due most likely to failures of some kind. Planned maintenance can actually generate a very significant amount of application service downtime as services are taken down to do performance optimization, server expansion or reconfiguration or database or file system backup. A truly comprehensive availability management solution targeted at maximizing application service uptime must offer options to address both planned and unplanned downtime.

An Overview of VERITAS Cluster Server (VERITAS CLUSTER SERVER)

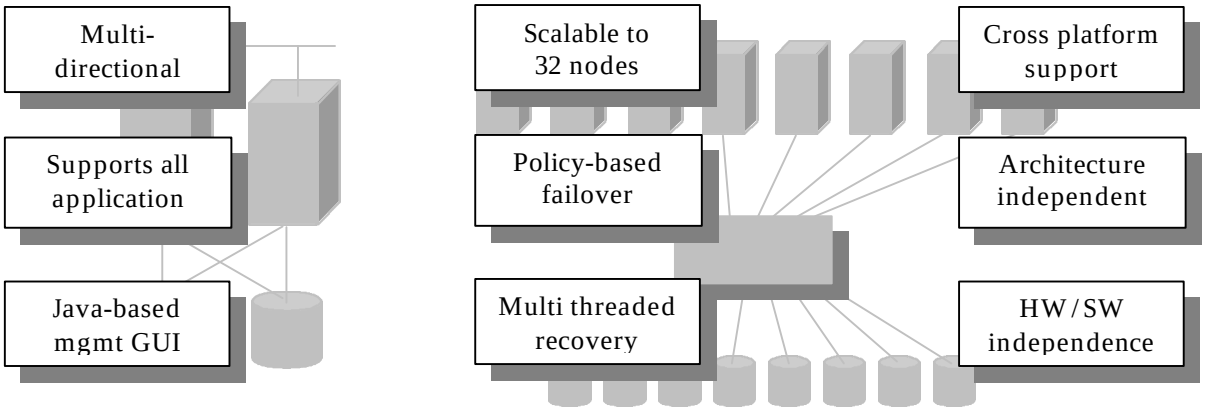

Figure 5. Summary of VERITAS CLUSTER SERVER features.

VERITAS Cluster Server is an architecture-independent, availability management solution focused on proactive management of service groups (application services). It is equally applicable in simple shared disk, shared nothing or SAN configurations of up to 32 nodes and compatible with single node, parallel and distributed applications. Cascading and multi-directional application failover is supported, and application services can also be manually migrated to alternate nodes for maintenance purposes. VERITAS Cluster Server provides a comprehensive availability management solution designed to minimize both planned and unplanned downtime.

Designed with a modular and extensible architecture to make it easy to install, configure and modify, VERITAS Cluster Server can be used to enhance the availability of any application service with its fully automated, application-level fault detection, isolation and recovery. All fault monitors, implemented in software, are monitored and can be automatically restarted in the event of a monitor process failure. Monitored service groups and resources can either be restarted locally or migrated to another node and restarted. A service group may include an unlimited number of resources. Various off-the-shelf agents are available from VERITAS to monitor specific applications such as file services, RDBMS and enterprise resource planning, or the product can be customized to monitor any hardware component or software-based service. An SNMP agent allows VERITAS Cluster Server to generate SNMP traps so that resource state changes can be communicated to any SNMP-based management tool such as HP OpenView, CA Unicenter, Tivoli TME and others. Although applicable to any application service that requires higher availability, VERITAS Cluster Server is most often deployed in mission-critical enterprise environments such as file serving, database and enterprise resource planning (ERP).

The Industry's Most Scalable Availability Management Solution

Conventional cluster products rely on inefficient, point to point fault management and heartbeat mechanisms that do not scale well to large cluster configurations. To ensure scalability, VERITAS

Cluster Server leverages a unique internode communication mechanism, called ClusterStat, which supports global atomic broadcast across a very low latency transport. This internode communication protocol is faster, more reliable and significantly more scalable than the protocols in any of today's existing cluster products. In addition, all fault management has been multi-threaded to speed recovery in large configurations, and efficient multi-level fault management ensures very low overhead in configurations which may include thousands of managed resources. VERITAS Cluster Server supports 32 nodes today, but VERITAS expects this product to support hundreds of nodes in the future.

Other features which support very large configurations include a Cluster Registry that is based on a single configuration file auto-replicated between all nodes, support for an unlimited number of service groups and a scalable, Java-based management GUI. A syntax checker built into the Cluster Registry minimizes operator error during configuration, and the registry supports dependency definitions between managed resources. During recovery, resources may either be started in parallel to speed recovery or according to the defined dependency hierarchy. An auto discovery capability automatically recognizes new nodes as they are added to the cluster and replicates the registry to them. Through the use of a scrollable Microsoft Explorer-like management interface, the VERITAS Cluster Server Manager (CSM) can easily provide a comprehensive view of the status of all service groups in a single cluster. Included is the ability to drill down for more detailed information or to perform administrative tasks with the click of a mouse button. It can also manage multiple clusters, if so configured, across up to 32 nodes in a SAN configuration from a single management console. VERITAS Cluster Server's ability to scale efficiently and manageably sets it apart from other availability management products on the market today.

As enterprises move to SAN architectures, the scalability of cluster management software will play a key role in efficiently leveraging large, centralized disk stores. More scalable software will allow more nodes to share centralized storage, thus optimizing the use of storage and minimizing availability management and administrative costs. It will also provide for an improved, long-term growth path, allowing more nodes and disk arrays to be added to accommodate even very rapid business expansion over a period of years.

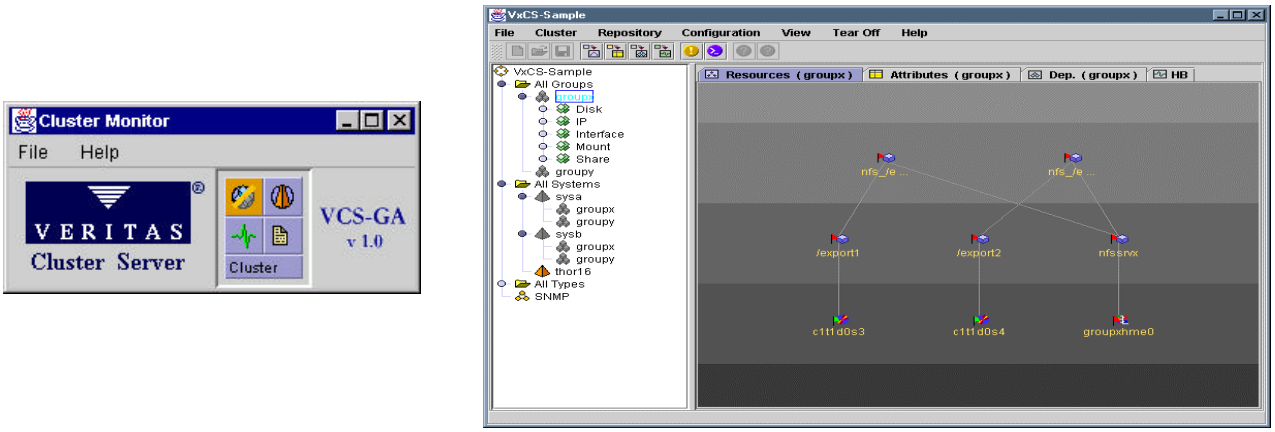

Figure 6. The CSM GUI provides status at a glance by cluster (Cluster Monitor for a 3 cluster SAN configuration shown on the left) as well as by resource group (resource map shows dependencies between resources within a single cluster).

Cross Platform Support

Due to its configuration flexibility, VERITAS Cluster Server will also be able to support a variety of hardware and software components, so very large SAN configurations can be built using products from a variety of different vendors. Initially, VERITAS Cluster Server will be available on Solaris, but efforts are already under way to port it to NT, HP-UX and Solaris x86. A variety of third party switch, hub, disk and tape products are supported as well. VERITAS' strategy is to produce a single, cross platform availability management tool to reduce administrative and training costs and provide a consistently robust solution across all the major enterprise platforms.

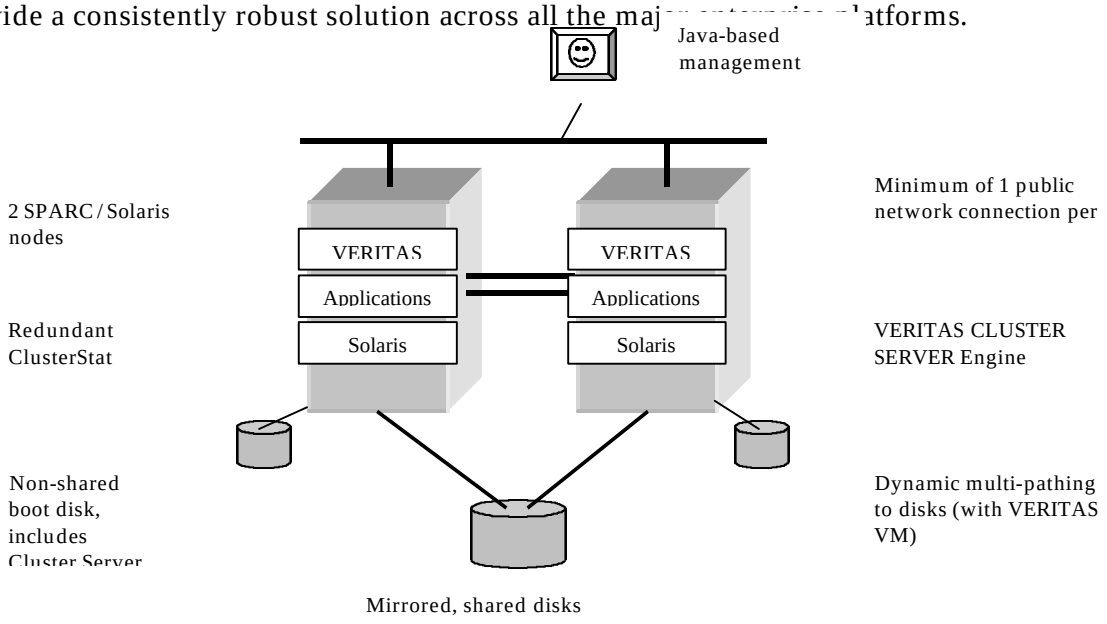

Figure 7. A basic two node VERITAS CLUSTER SERVER configuration.

The Comprehensive Availability Management Solution

Implementing availability management solutions is done with a single goal in mind: to reduce the impact of downtime on business operations. To maximize availability, a comprehensive approach that addresses all potential failures and all potential administrative causes of downtime should be implemented. VERITAS provides an end to end storage management solution that protects availability from the point of data creation, through storage and use, to backup and offsite archiving. Integration points with VERITAS Cluster Server all along this "data life cycle" for all of VERITAS' products keep data available so that application services can remain available.

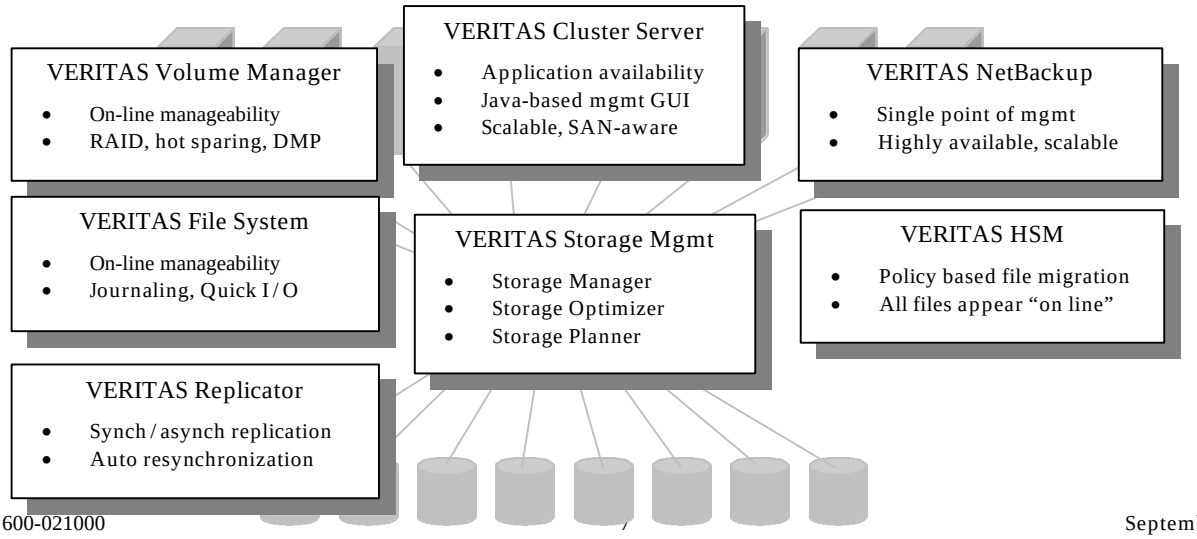

Figure 8. The VERITAS end-to-end storage management offering.

On-line storage management tools such as VERITAS Volume Manager and File System provide various data availability options as well as allowing common administrative tasks to be performed without shutting off client access to the data. VERITAS Storage Replicator can replicate data between multiple nodes and multiple sites to support disaster recovery and replicated application environments.

VERITAS' suite of Storage Resource Management tools support policy-driven storage management that can increase overall availability, tune to meet defined performance metrics automatically and aid in storage capacity planning. VERITAS NetBackup provides a single point of backup and restore management that can scale to support thousands of nodes in an enterprise wide environment.

VERITAS HSM can be used to manage the automatic migration of files, by usage and cost of storage device, within a pre-defined storage hierarchy, while making all files appear on-line to all users at all times. Each of these products has at least one integration point with VERITAS Cluster Server to make it a highly available service. By leveraging VERITAS Cluster Server's fault management capabilities, and the on-line management capabilities of the rest of the VERITAS' end to end storage management offering, customers can proactively manage planned and unplanned downtime, thereby maximizing overall application availability.

VERITAS: The Safe Business Choice

When choosing an availability management solution, a comprehensive product offering is an absolute requirement, but other external criteria are important as well. All aspects of the business relationship between customer and provider should be evaluated. As a $200M provider of end to end storage management solutions with a twenty-year development history, VERITAS offers an enterprise support infrastructure. A full suite of consulting services can help customers with strategic and tactical deployments, and field deployments are backed by technical support (5 x 12 or 7 x 24), education and training classes designed to help customers get the most out of their VERITAS solutions and a strong development organization. As a financially solid vendor with strong fiscal and corporate management, VERITAS continues to grow at 65-70% year, providing ample capital to invest in and stay ahead of our customers' enterprise support infrastructure requirements while continuing to fund innovative technological advancements.

VERITAS' strategy is to provide cross-platform storage management tools designed to improve the performance, availability and manageability of storage throughout its entire life cycle. Buttressed by a strong indirect channel which has placed VERITAS products across 52 platforms, including industry leaders such as Microsoft, Sun, HP, Compaq, Dell and IBM, VERITAS also supports a strong direct channel product offering focused on providing core technologies on the NT, Solaris

and HP-UX platforms. Our other development partners include the enterprise players most often deployed in the Fortune 2000 such as Oracle, Sybase, Informix, SAP, EMC, StorageTek, DG Clariion, Hitachi Data Systems, Symbios (LSI Logic), Digital StorageWorks, Brocade, Vixel, Gadzoox, CNT, AXENT Raptor and Checkpoint Systems. Our availability management product deployment strategy mirrors our broader corporate strategy, offering solutions available today on Solaris, NT and HP-UX. If customers are deploying enterprise-wide information management solutions, regardless of the platform, chances are they are either already using VERITAS products or have chosen key partners shared with VERITAS.

The very nature of our cross-platform strategy requires VERITAS to provide heterogeneous storage management solutions. Pre-existing relationships with the key industry players ensure that, if problems arise, pre-defined channels exist for rapid problem resolution. By offering customers an ability to use a common storage management solution that is compatible with their heterogeneous environments, VERITAS offers a way to cut cross-platform administrative and training costs as well as minimize vendor management issues through a reduction of required suppliers.

With over a million licenses outstanding across our entire product line, VERITAS has a huge installed base of existing customers. VERITAS is happy to provide references and would encourage prospective customers to explore how their peers have addressed their storage and availability management requirements with VERITAS product.

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