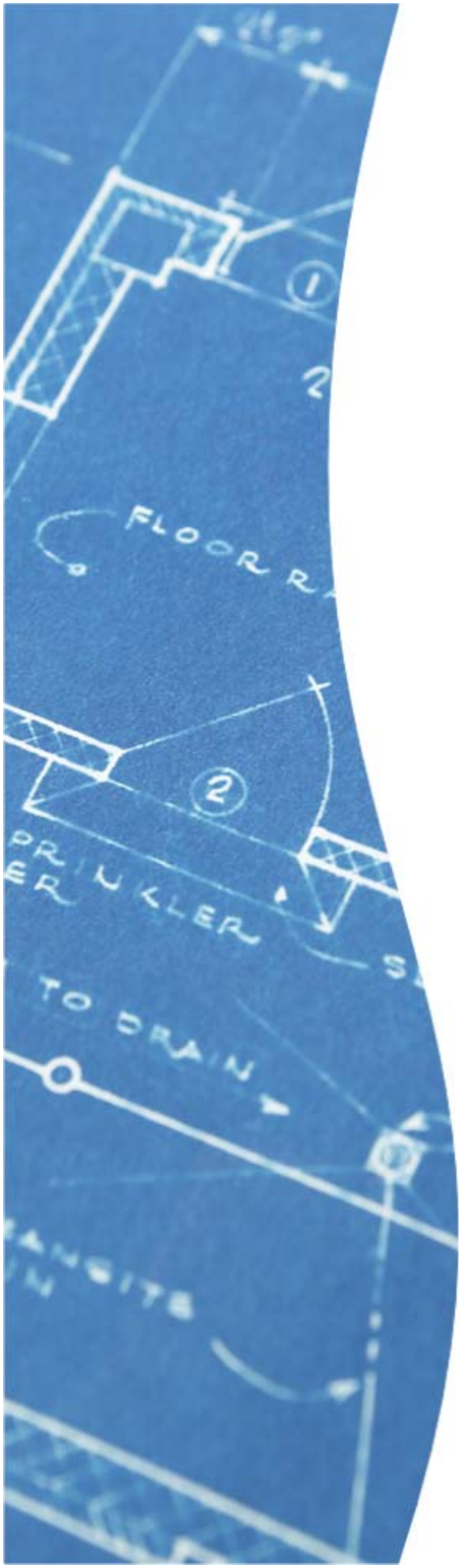

SUN'S REFERENCE ARCHITECTURE FOR **NEXT-GENERATION DATA BACKUP**

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Sun BluePrints™ On-Line — Reference Architecture

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Chapter 1

Introduction to Next-Generation Data Backup

Virtually every company, regardless of size or industry, needs data archive capabilities. And customers across all industry segments are faced with similar archive challenges: explosive data growth, pressure to meet promised service levels and backup windows for users, 'forever' archive data retention and retrieval requirements, and rising energy costs. Their data protection environments are becoming larger, more complex, increasingly diverse, and often contain disparate islands of archive data to manage. Administrators face the challenges of meeting the growing data backup requirements and providing a comprehensive backup solution, while maintaining costs and building a platform that will continue to meet future demands.

To help solve these challenges, Sun is developing and delivering openly architected, intelligent, and massively scalable general purpose archive solutions with breakthrough cost structures. Using the Symantec NetBackup software and powered by the Sun SPARC® Enterprise servers and Solaris™ operating system (Solaris OS), these solutions deliver next-generation data protection for large heterogeneous environments. The flexible, multi-tier architecture provides virtually unlimited scalability with central management and end-to-end data protection across heterogeneous technologies.

Sun's Reference Architecture for Next-Generation Data Backup

The Sun reference architecture for next-generation data backup was designed as a solution for networks with large numbers of heterogeneous clients. Based on common implementations of existing customer environments, the target environment included backup clients connected via a local area network (LAN) with both 100 Mb and 1 Gb Ethernet network links. The client network included a realistic mix of Windows, Linux, HP/UX, AIX, and the Solaris operating systems.

Achieving a competitive price/performance metric for this NetBackup solution was a key objective of this reference architecture. Additional objectives included determining performance and sizing characteristics of the proposed architecture. This included establishing the number of Sun StorageTek™ T10000 tape drives, running at 120 MB/sec, that could be supported, along with an understanding of the configuration and steady-state CPU utilization required to reach that level of performance.

Sun SPARC Enterprise servers, running the Solaris 10 08/07 OS, were used as the foundation of the NetBackup reference architecture. The Sun SPARC Enterprise T5220 server, powered by the UltraSPARC T2 processor, was an attractive choice for the backup server, as it is designed with the new generation PCI Express (PCIe) I/O infrastructure. As results show, the Sun SPARC Enterprise T5220 was found to be the preferred

hardware platform, because of its demonstrated lead in price/performance observed in testing. When tested in an optimal configuration, this server was able to drive 16 Sun StorageTek T10000 tape drives at maximum speed (120 MB/sec), with a sustained throughput of 1700 MB/sec and a steady 40% CPU utilization.

Scope of this Document

This document describes the Sun reference architecture for next-generation data backup using Symantec NetBackup software.

- "Architecture Overview" on page 3 presents the hardware and software components used to implement the reference architecture.
- "Implementation and Configuration" on page 9 describes the hardware configuration details and suggested tuning for the Solaris OS and Symantec NetBackup software.
- "Performance Characterization and Sizing" on page 15 includes details on the testing performed to help guide sizing and implementation recommendations, and contrasts results using Sun SPARC Enterprise T5220 and M5000 servers as the NetBackup media servers.

Chapter 2

Architecture Overview

The following sections describe the key components of Sun's Reference Architecture for next generation data backup using Symantec NetBackup software. Hardware and software components are described along with their interaction with other components in the reference architecture.

Reference Architecture Components

In the reference architecture, the Symantec NetBackup software is used to provide tape-based data protection, archival, and recovery management for a large network of heterogeneous clients. Powered by the Sun SPARC Enterprise T5220 server and Sun StorageTek tape drives and libraries, the solution scales to support a network with a large number of clients running a mix of Windows, Solaris, Linux, HP/UX, and AIX operating systems (see Figure 1).

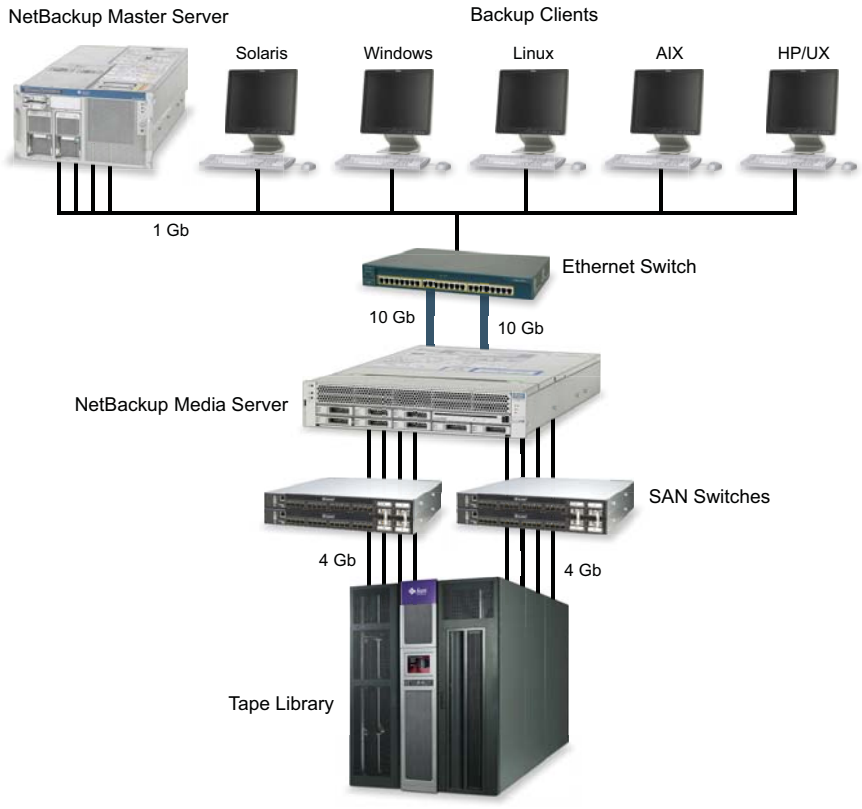

Figure 1. Functional components of the Sun references architecture for next generation data backup using Symantec NetBackup software.

This solution includes a scalable, three-tier architecture including backup clients, media servers, and master servers. The base reference architecture includes a single NetBackup master server, and a single NetBackup media server with an attached tape library to store the backup data. This configuration serves a network environment with numerous backup clients running heterogeneous operating systems.

The primary logical components include:

- *NetBackup Master Server*
  The NetBackup master server performs all NetBackup administrative functions and controls the backup scheduling for each media server. As part of this job, the NetBackup master server uses the Sybase Database Management System (DBMS) to keep track of which files are stored on tape. A Sun SPARC Enterprise M4000 server was deployed in this reference architecture as the master server. This server was chosen because it is expected to perform better when interacting with the Sybase DBMS, which does not currently include a fully threaded implementation, than the Sun SPARC Enterprise T5220 server.
- *NetBackup Media Servers*
  The media server performs the backup operations under the direction of the master, with all backup data stored locally on the media server and its respective storage devices. A Sun SPARC Enterprise T5220 server was deployed as the media server in this reference architecture.
- *Tape Drives and Tape Libraries*
  A wide variety of tape drives and tape libraries are supported by the NetBackup software. This reference architecture employed a Sun StorageTek SL8500 modular library system with 16 Sun StorageTek T10000 tape drives.
- *Backup Clients*
  This Reference Architecture included backup clients running the Windows 2003, Windows XP, Linux, Solaris, AIX and HP/UX operating systems.
- *Ethernet Switches*
  Ethernet switches were used to provide connections and link aggregation between the backup clients, media servers, and master server using network speeds of 100 Mb/sec, 1 Gb/sec, and 10 Gb/sec.
- *SAN Switches*
  SAN switches were used to provide Fibre Channel connections between the NetBackup media servers and the tape libraries.

While this reference architecture includes a single NetBackup media server, multiple media servers can be deployed to support the clients on the backup network. This design provides a highly scalable solution, as additional media servers can be added to address scalability requirements as needed.

Symantec NetBackup Software

This reference architecture used the Symantec NetBackup 6.5.2 software. This software provides a high performance and scalable data protection solution for large heterogeneous environments. A single console is used for all backup and recovery operations, enabling backup administrators to centrally mange their backup, archive and recovery infrastructure.

The NetBackup software accommodates multiple servers working together under the administrative control of one server. In this relationship, the NetBackup administrative control server is designated to be the *master* server, with the other servers designated as *media* servers, operating under control of the master server. A master server and its associated media servers are referred to collectively as a *NetBackup storage domain*. Large networks may have more than one domain.

All NetBackup administrative functions are performed centrally from the master server, and the master server controls all backup scheduling for each media server. Each of the media servers performs the actual backup operations for client systems under direction from the master, and backup data stays local to the media servers and their respective storage devices. A master server can also function as a media server.

For more information on the Symantec NetBackup software, see:
`http://www.symantec.com/business/products/whitepapers.jsp?pcid=2244&pvid=2_1`

Sun SPARC Enterprise Servers

This next-generation data backup reference architecture features two members of the Sun SPARC Enterprise server family: a SPARC Enterprise M4000 server deployed as the NetBackup master server, and a SPARC Enterprise T5220 server deployed as the NetBackup media server.

Sun SPARC Enterprise M4000 Server as Master Server

The Sun SPARC Enterprise M4000 server represents a mid-range data center-class server, optimized for mission critical computing and providing mainframe RAS capabilities in a 6 RU form factor. Powered by up to four dual-core SPARC64 VI processors, the Sun SPARC Enterprise M4000 server is deployed as the NetBackup master server in the reference architecture. The Sun SPARC Enterprise M4000 server was selected to perform the task of the NetBackup master server primarily because of its fast DBMS response time.

The NetBackup DBMS Catalog that is maintained by the master server can grow to well over 500 GB, especially in large environments or when data retention policies dictate long or infinite data retention periods. In these cases, the size of the catalog can exceed the storage capacity of the two internally available disks on the SPARC Enterprise

M4000 server. In order to accommodate this growth, additional Fibre Channel or SCSI cards, typically in pairs for redundancy, and additional external disks should be added to support the growth of the DBMS catalog on the master server.

The Sun SPARC Enterprise M4000 server is shown in Figure 2.

Figure 2. Sun SPARC Enterprise M4000 server.

Features of the Sun SPARC Enterprise M4000 server include:

- Up to four high performance dual core SPARC64 VI processors
- Up to 128 GB memory
- A 6 RU rack optimized enclosure with PCI-X and PCIe I/O expandability

Sun SPARC Enterprise T5220 Server as Media Server

The Sun SPARC Enterprise T5220 server combines unmatched performance and scalability in an energy-efficient and compact 2 RU form factor. Powered by the Chip Multithreading Technology (CMT) UltraSPARC T2 processor, the Sun SPARC Enterprise T5220 server is deployed as the NetBackup media server in the reference architecture. The Sun SPARC Enterprise T5220 server is shown in Figure 3.

Figure 3. Sun SPARC Enterprise T5220 server.

Features of the Sun SPARC Enterprise T5220 server include:

- UltraSPARC T2 processor, with up to eight cores and 64 simultaneous threads of execution
- Up to 64 GB of memory
- Dual multi threaded 10 Gb Ethernet and a separate 8 Lane PCI Express root integrated on the processor
- Integrated on-chip cryptographic acceleration

Solaris 10 Operating System

All servers in the reference architecture run the Solaris 10 OS. The latest version of Sun's enterprise-class operating system, the Solaris 10 OS provides superior scalability, availability, manageability, and security. With its optimized network stack and support for today's advanced network protocols, the Solaris 10 OS delivers high-performance networking. Innovative features new to the Solaris 10 OS, such as Predictive Self Healing, support automatic diagnosis and recovery from hardware and application faults, maximizing system uptime, while the Solaris Dynamic Tracing Facility (DTrace) enables real-time application debugging and optimization.

Sun StorageTek Tape Drive and Library Products

While the NetBackup platform supports a variety of storage products, the Sun reference architecture features the Sun StorageTek SL8500 modular library system and StorageTek T10000 tape drives.

Sun StorageTek SL8500 Modular Library System

The StorageTek SL8500 modular library system, shown in Figure 4, is Sun's ultimate tape library for scalable offline storage and fast retrieval. This system currently scales from 1,448 slots to 70,000 slots and supports a combination of 64 to 4481 tape drives including the Sun StorageTek T10000, T9840, T9940 lines of tape drives along with LTO, SDLT, and DLT-S4 tape drives. Designed for extreme modular scalability without downtime, this system includes redundant hot-swappable robotics, power and electronic components to maximize availability.

Figure 4. Sun StorageTek SL8500 modular library system.

While the Sun StorageTek SL8500 modular library system is ideally suited for large scale environments, the StorageTek SL300 modular library system may be preferred for smaller environments. A fully redundant midrange solution, the StorageTek SL3000 modular library system scales up to 56 drives and expands from 200 to 3,000 cartridge slots.

Sun StorageTek T10000 Tape Drive

The Sun StorageTek T10000 tape drive, shown in Figure 5, delivers a capacity of 500 GB uncompressed data and a throughput of 120 MB per second. These drive efficiencies help enable data centers to store more data in the same footprint and shorten backup and recovery windows. The Sun StorageTek T10000 tape drives support demanding, high-duty cycle environments with dual-head, 32-channel technology, reducing the number of tape passes and extending head and media life. These tape drives connect using standard FICON and dual-port Fibre Channel options, for compatibility with most storage environments.

Figure 5. Sun StorageTek T10000 tape drive.

The Sun next-generation data backup reference architecture includes up to 16 Sun StorageTek T10000 tape drives in a StorageTek SL8500 modular library system.

Chapter 3

Implementation and Configuration

While every deployment is unique, the configuration presented here demonstrates one example of how a next-generation data backup solution using Symantec NetBackup software can be implemented.

Hardware Components

The Sun Reference Architecture features a Sun SPARC Enterprise M4000 server as the NetBackup master server, a Sun SPARC Enterprise T5220 server as the media server, and a Sun StorageTek SL8500 Modular Library System (see Figure 6). Multiple heterogeneous backup clients are connected via the Ethernet network using a Cisco 6513 LAN Ethernet switch.

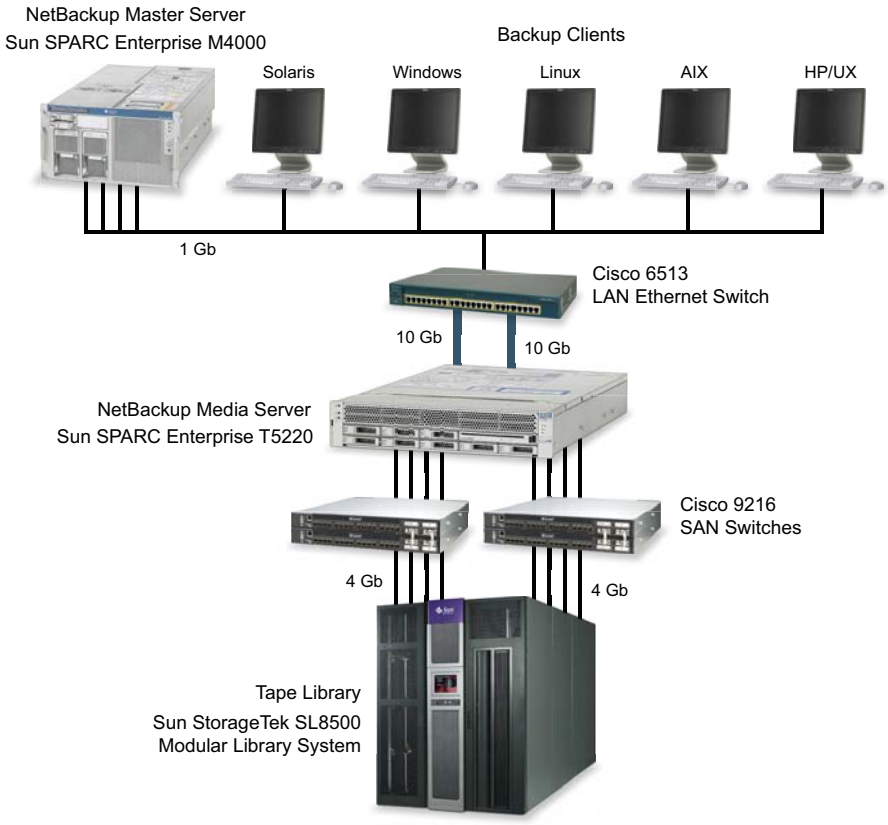

Figure 6. Sun Reference Architecture for NetBackup.

NetBackup Master Server

General configuration details for Sun SPARC Enterprise M4000 server used as the NetBackup master server are listed in Table 1:

Table 1. NetBackup server requirements.

Component	Requirements
Processors	Four SPARC64 VI dual core 2.15 GHz processors
Memory	32 GB memory
I/O Connectivity	Four 1 Gb Ethernet ports (2 built-in 1 Gb Ethernet ports, 1 dual port 1 Gb Ethernet HBA)
Operating System	Solaris 10 (08/07) OS with all available patches
Backup Software	Symantec NetBackup 6.5.2 software

NetBackup Media Server

General configuration details for the SPARC Enterprise T5220 server used as the NetBackup media server are listed in Table 2. Two 10 Gb connections are used between the Cisco 6513 LAN Ethernet switch and the media server for network connectivity.

Table 2. NetBackup media server requirements.

Component	Requirements
Processors	Eight-core UltraSPARC T2 1.4 GHz processor (64 execution threads)
Memory	64 GB memory
I/O Connectivity	Two 10 Gb XAUI PCIe Ethernet cards, with Long Reach GBICs on both ends of the connections and category 7 fiber for the connection
Fibre Channel connectivity	Four 4 Gb dual port FC cards (Eight 4 Gb FC ports total)
Operating System	Solaris 10 (08/07) OS with all available patches
Backup Software	Symantec NetBackup 6.5.2 software

Storage Area Network

The Sun reference architecture employs a Storage Area Network (SAN) to maintain the backup data. A Sun StorageTek SL8500 modular library system is equipped with 16 StorageTek T10000 tape drives. Two SAN switches are used to provide redundancy and increased bandwidth. Each Cisco 9216 SAN switch provides four 4 Gb links between the tape library and the media server in the reference architecture.

General configuration details for the reference architecture SAN include:

- Sun StorageTek SL8500 modular library system
- Sun StorageTek T10000 tape drives (16 total)
- Dual SAN switches, each with four 4 Gb connections to the tape drives

NetBackup Clients

The reference architecture supports heterogeneous NetBackup clients connected via a LAN. Clients can be divided into two separate classes: slower clients, connecting via 100 Mb Ethernet connections; and faster clients, connecting via 1 Gb Ethernet connections. General configuration details for the clients are listed in Table 3.

Table 3. NetBackup client requirements.

Component	Requirements
I/O Connectivity	1 Gb or 100 Mb Ethernet connections
Operating System	Windows 2000, Windows 2003, AIX, HP/UX, Solaris 10 (SPARC and x86) OS
Backup Software	Symantec NetBackup 6.5.2 software

Software Components

The Symantec NetBackup 6.5.2 software was used by all servers and clients in the backup environment. The NetBackup master and media servers all ran the Solaris 10 08/07 OS. Additional software tuning was performed, as described in “System Configuration and Tuning” on page 12, to improve performance.

- *Solaris 10 OS*
  The NetBackup master and media servers had the Solaris 10 (08/07) OS installed, and were up to date with the latest patches available. Patches can be downloaded from `http://www.sunsolve.com`.
- *NetBackup 6.5.2 Software*
  The Netbackup 6.5.2 software was installed on the master and media servers, and all clients in the network.
- *Server Firmware*
  The firmware levels on the Sun SPARC Enterprise servers deployed as NetBackup master and media servers should be verified, and updated if necessary. The latest firmware revisions are available for download from `http://www.sunsolve.com`.

Installation Overview

A comprehensive installation procedure is outside the scope of this document. Briefly, the main steps include installing and configuring the NetBackup 6.5.2 software on the various components in the backup network, and performing system tuning to improve performance.

1. Install and configure the master server.
   a. Install the Solaris 10 OS and all patches. For the testing described in this document, Solaris 10 (08/07) OS with all patches as of February 1, 2008, was installed.
   b. Verify the server firmware is the most recent release, and update if needed.
   c. Install the NetBackup 6.5.2 software.
2. Install and configure the media server.
   a. Install the Solaris 10 (08/07) OS and all patches.
   b. Verify the server firmware is the most recent release, and update if needed.
   c. Install the NetBackup 6.5.2 software.
   d. Perform Solaris OS and NetBackup configuration and tuning, as described in "System Configuration and Tuning" on page 12.
3. Install and configure the clients.
   a. Install the NetBackup 6.5.2 client software.
   b. Perform NetBackup configuration, as described in "System Configuration and Tuning" on page 12.
4. Configure NetBackup policies and queues on the master server.

   For better performance, configure multiple backup queues. In addition, segregate clients into separate queues, with one set of queues for clients using 100 Mb/sec or slower NICs and another set of queues for clients using 1 Gb/sec or faster Ethernet connections.

See the Vertitas NetBackup 6.5.2 documentation set for detailed instructions on installing and configuring the software on the various systems in the backup network.

System Configuration and Tuning

The Solaris 10 OS and the NetBackup software were both configured for better backup performance.

Solaris OS Configuration

Various parameters defined within the Solaris 10 08/07 OS were tuned on the NetBackup media server to achieve higher levels of performance.

- *Increasing the DMA buffers*

  The `ip_soft_rings_cnt` parameter in the `/etc/system` file was modified from the default setting to the following:

```
set ip:ip_soft_rings_cnt=16
```

  This change increases the DMA buffers for the network interface cards, allowing the server to better utilize the available threads to handle interrupts.

If the PCIe Dual 10 Gb Ethernet card is used rather than the XAUI card, the following parameter should also be modified:

```
set ddi_msix_alloc_limit=8
```

After performing these changes, reboot the server in order for the changes to take effect.

- *Deferred ACK Configuration*
  Since backup servers receive large amounts of data and transmit network protocol acknowledgments (ACKs) most of the time, the Solaris kernel parameters were modified to reduce the number of outgoing ACKs for better performance. The following two `ndd` commands were executed on the NetBackup media server in the reference architecture:

```
# ndd -set /dev/tcp tcp_deferred_acks_max 16
# ndd -set /dev/tcp tcp_local_dacks_max 16
```

  The first command modifies the `tcp_deferred_acks_max` parameter, which specifies the maximum number of TCP segments received from remote destinations before an ACK is generated. This command dynamically changes the value for deferred ACKs from the default of 2 to the new value of 16. The second statement modifies the `tcp_local_dacks_max` parameter, and dynamically changes the maximum number of deferred ACKs for the local subnet(s) from the default of 8 to the new value of 16.

For more information on tuning Solaris OS internals, please see the following resources:

- `http://www.solarisinternals.com/wiki/index.php/Networks`
- `http://blogs.sun.com/puresee/entry/10_gigabit_ethernet_on_ultrasparc`

NetBackup Configuration

Policy-based multiplexed queues were used with the NetBackup software to prevent the slower clients from interfering with the performance of the faster clients. Policies were established to set up a *slow queue* for LAN clients with 100 Mb/sec LAN I/O bandwidth, and a *fast queue* for networked clients with 1 Gb/sec LAN I/O bandwidth. Multiple queues were used to keep the NetBackup media server fully utilized. Specifically, eight data streams (queues) were created for the test environment:

- Four for fast (1 Gb/sec) clients
- Four for slow (100 Mb/sec) clients

In addition, the NetBackup software parameters listed in Table 4 were tuned to use the indicated values:

Table 4. NetBackup parameter tuning.

Component	Parameter	Value
NetBackup Media Server	SIZE_DATA_BUFFERS	262144
	NUMBER_DATA_BUFFERS	32
	NET_BUFFER_SZ	65536
NetBackup Clients	NET_BUFFER_SZ	65536

On systems running the Solaris OS, the following commands can be used to set the NetBackup parameters. These commands create a file with the same name as the parameter, and insert the indicated value.

```
# echo "262144" > /usr/openv/netbackup/db/config/SIZE_DATA_BUFFERS
# echo "32" > /usr/openv/netbackup/db/config/NUMBER_DATA_BUFFERS
# echo "65536" > /usr/openv/netbackup/NET_BUFFER_SZ
```

It is recommended that the same value for NET_BUFFER_SZ be set on all the NetBackup servers and clients in the domain.

For more detailed information and instructions on setting the NetBackup software parameters on other operating systems, please see the Symantec NetBackup 6.0 documentation set.

Chapter 4

Performance Characterization and Sizing

Proof of Concept testing was performed to determine the performance characteristics of the reference architecture. Initial testing compared the use of a Sun SPARC Enterprise M5000 server and a Sun SPARC Enterprise T5220 server as the NetBackup media server in the test environment. Based on the results of this initial test, the proof of concept study further investigated three different LAN connectivity configurations for the Sun SPARC Enterprise T5220 server.

The testing was executed using Symantec Netbackup 6.5.2 software to perform network-based backups from the multiple test clients. The test plan called for several testing scenarios. Based on recommendations from Symantec, clients were divided into two categories: slower network clients and faster network clients. NetBackup tuning was conducted after each test iteration to improve performance to an observable maximum.

Test Environment

The test environment consisted of a NetBackup master server, a single NetBackup media server, and multiple NetBackup clients running NetBackup 6.5.2 software. Two separate media servers were tested — a Sun SPARC Enterprise M5000 server and a Sun SPARC Enterprise T5220 server — each configured with the Solaris 10 (08/07) operating system software. A Sun Fire™ V490 server, configured with four UltraSPARC VI+ 1.5 GHz processors, 32 GB of memory, and four 1 Gb Ethernet ports, was used as the NetBackup master server during testing.

Note – While a Sun Fire V490 server was used as the NetBackup master server in the test environment for convenience, lab observations support the use of a Sun SPARC Enterprise M4000 server, configured with four SPARC64 VI Dual core 2.15 GHz processors, 32 GB of memory, and quad 1 Gb Ethernet ports, as a NetBackup master server.

A total of 88 NetBackup clients, running the Windows 2000, Windows 2003, AIX, HP/UX, and Solaris 10 OS, were used to generate the client workload in the test environment. A total data load of 5.3 TB was distributed across the 88 client systems, with each client containing approximately 460 GB of data to backup. Total elapsed time for each test run included the time required to mount the tape devices and ended when the entire 5.3 TB of data was completely written to tape.

A review of the this target client environment by Symantec's professional services indicated that 19 Gb worth of LAN throughput, 24 GHz worth of CPU power, and a policy of separating slower LAN clients in a different queue from the faster LAN clients would

be required in order to support the ultimate target requirement of 2500 NetBackup clients. These baseline numbers were used to determine the starting point for testing media servers.

Test Client Network Layout

The network layout used for the test environment is illustrated in Figure 7. The NetBackup clients were distributed in a local area network using several hops, separating clients with slower network interface cards (NICs) and those with faster NICs. Fourteen Windows 2003 clients were connected with 100 Mb/second NICs to simulate the slower clients in a typical network. This network configuration was chosen to demonstrate the performance of a NetBackup 6.5.2 environment that is multiplexed using a policy that divides fast and slow clients in order to improve performance and throughput of client jobs.

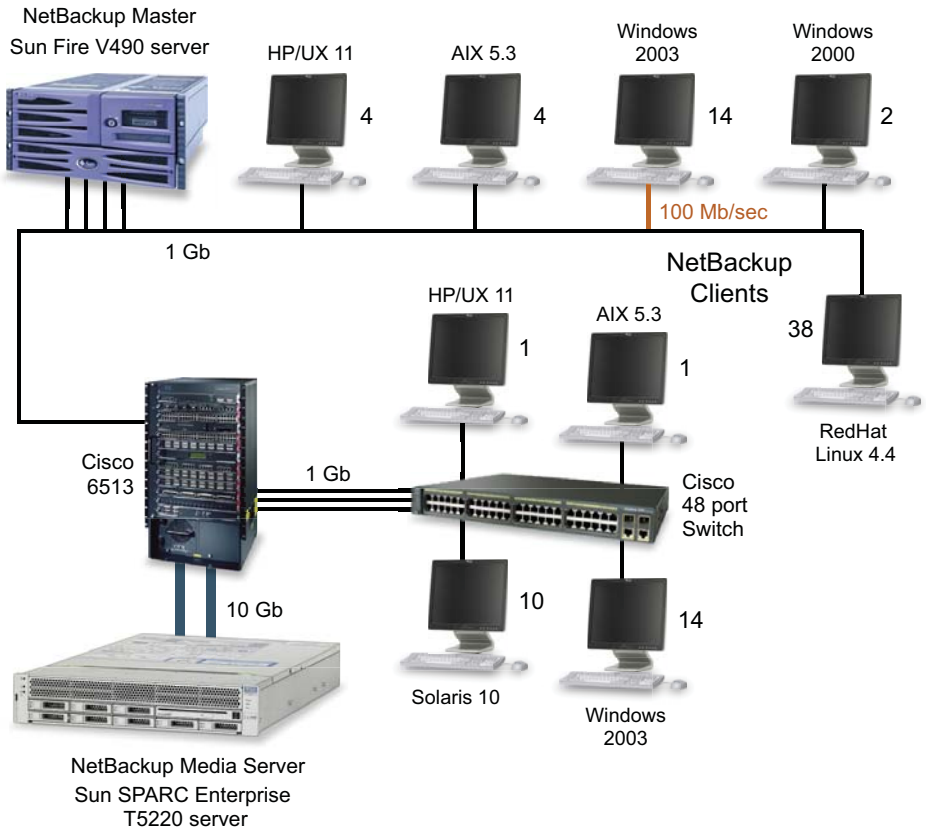

Figure 7. Test environment network layout.

The media servers were connected via one 10 Gb/second Ethernet connection through a Cisco 6513 Ethernet switch to form a LAN for the initial testing. Subsequent testing was done with two 10 Gb connections for the media server, and finally with twelve 1 Gb

Ethernet connections that were set up to use round robin DNS via two six port trunks using Cisco LACP trunking. (The media server configuration shown in Figure 7 is the second Sun SPARC Enterprise server configuration tested, with two 10 Gb connections.)

The test environment included up to 16 Sun StorageTek T10000 tape drives in a Sun StorageTek SL8500 modular library system on a SAN. The tape drives were connected to the media servers via 4 Gb/second dual-port Fibre Channel interfaces. The available PCIe slots in the Sun SPARC Enterprise T5220 server allowed for four of these Fibre Channel interfaces; the Sun SPARC Enterprise M5000 server allowed for five (or more) of these interfaces.

Sun SPARC Enterprise M5000 Server Configuration

The Sun SPARC Enterprise M5000 server system layout is depicted in Figure 8, and configuration details are summarized in Table 5. The Sun SPARC Enterprise M5000 server used eight SPARC64 VI dual core 2.15Ghz processors (sixteen cores), and 64 GB of memory. The Sun SPARC Enterprise M5000 server included five 4 Gb dual-port Fibre Channel host bus adapters (HBAs) for accessing the SAN and tape drives, and was configured with one 10 Gb Ethernet card.

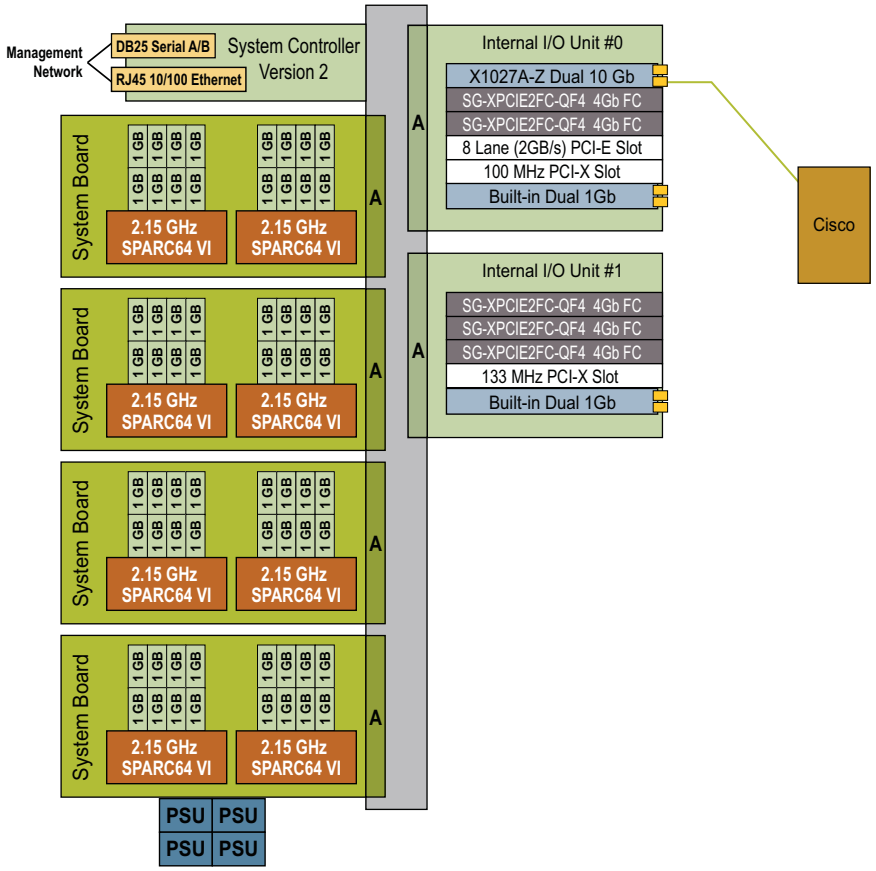

Figure 8. Sun SPARC Enterprise M5000 server system layout.

Table 5. Configuration details for Sun SPARC Enterprise M5000 server.

Component	Description
Processors	Eight SPARC64 VI dual-core CPUs (2.15 GHz)
Memory	64 GB memory (1 GB DIMMs)
Disk	One SE3120 disk array: • Two 73 GB disks One D240 disk array: • Two 73 GB disks • One DVD • One DAT drive
TCP/IP Data Connections	One dual-port 10 Gb Ethernet card Total of 10 Gb I/O bandwidth
TCP/IP Management Ports	One 1 Gb Ethernet management port One 1 Gb Ethernet public network port
Fibre Channel Connections	Five 4 Gb dual-port FC cards (Ten 4 Gb FC ports) One 4 Gb port per StorageTek T10000 tape drive

Sun SPARC Enterprise T5220 Server Configuration

The Sun SPARC Enterprise T5220 server used one UltraSPARC T2 1.4Ghz processor (eight cores), and 64GB of memory. Four 4 Gb Dual Port Fibre Channel HBAs (the maximum available) were used for accessing the SAN and the tape drives. The Sun SPARC Enterprise T5220 server was tested in three configurations which differ in LAN connectivity only.

Configuration A

The first Sun SPARC Enterprise T5220 server configuration used one 10 Gb XAUI Ethernet card. This configuration is depicted in Figure 9 and summarized in Table 6.

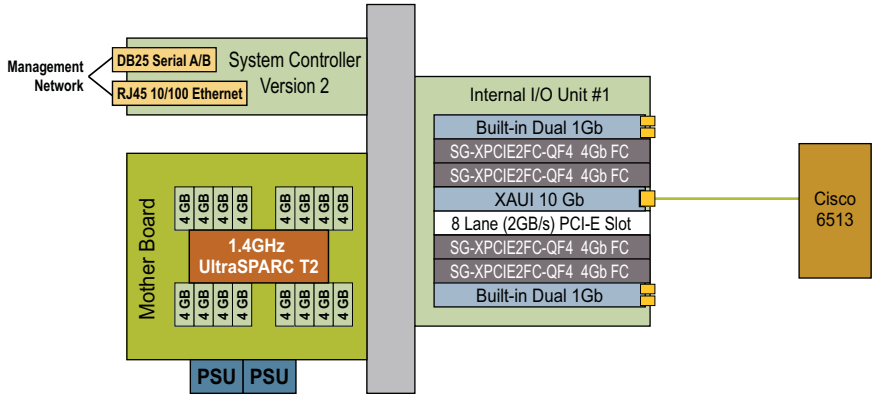

Figure 9. Sun SPARC Enterprise T5220 server system layout, Configuration A.

Table 6. Configuration details for Sun SPARC Enterprise T5220 server (Configuration A).

Component	Description
Processors	One UltraSPARC T2 processor — 1.4 GHz, 8 core CPU (64 threads)
Memory	64 GB memory (4 GB DIMMs)
Disk	Four SAS internal hard disk drives (148 GB)
TCP/IP Data Connections	One 10 Gb XAUI PCIe Ethernet card Total of one connection (10 Gb/sec)
TCP/IP Management Ports	One 1 Gb Ethernet management port One serial management port
Fibre Channel Connections	Four 4 Gb dual-port FC cards (Eight 4 Gb FC ports)

Configuration B

The second configuration tested for the Sun SPARC Enterprise T5220 server used two 10 Gb XAUI Ethernet cards. This configuration is depicted in Figure 10 and summarized in Table 7.

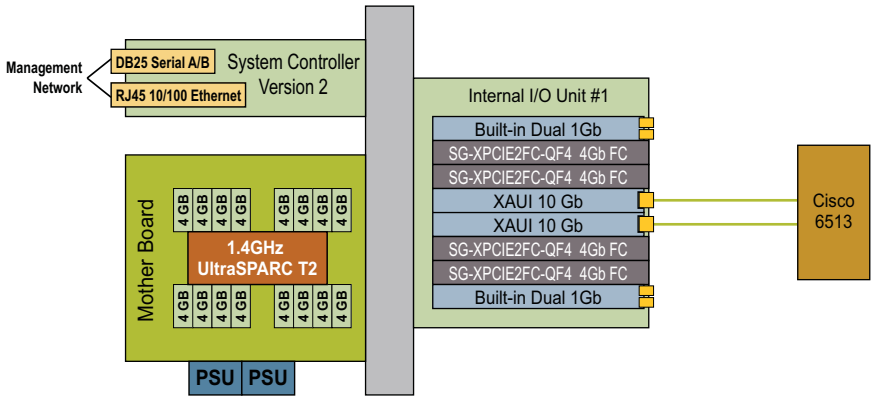

Figure 10. Sun SPARC Enterprise T5220 server system layout, Configuration B.

Table 7. Configuration details for Sun SPARC Enterprise T5220 server (Configuration B).

Component	Description
Processors	One UltraSPARC T2 processor — 1.4 GHz, 8 core CPU (64 threads)
Memory	64 GB memory (4 GB DIMMs)
Disk	Four SAS internal hard disk drives (148 GB)
TCP/IP Data Connections	Two 10 Gb XAUI PCIe Ethernet cards Total of two connections (20 Gb/sec total)
TCP/IP Management Ports	One 1 Gb Ethernet management port One serial management port
Fibre Channel Connections	Four 4 Gb dual-port FC cards (Eight 4 Gb FC ports)

Configuration C

The final configuration tested for the Sun SPARC Enterprise T5220 server used two 1 Gb/second quad-port Ethernet cards plus the four built-in 1 Gb/second Ethernet ports, for a total of twelve 1 Gb/second ports. This configuration is depicted in Figure 11 and summarized in Table 8.

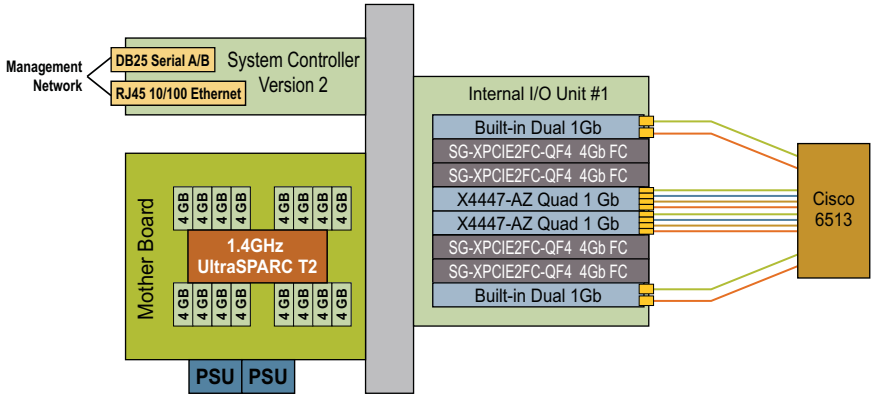

Figure 11. Sun SPARC Enterprise T5220 server system layout, Configuration C.

Table 8. Configuration details for Sun SPARC Enterprise T5220 server (Configuration C).

Component	Description
Processors	One UltraSPARC T2 processor — 1.4 GHz, 8 core CPU (64 threads)
Memory	64 GB memory (4 GB DIMMs)
Disk	Four SAS internal hard disk drives (148 GB)
TCP/IP Data Connections	Two 1 Gb/sec quad-port Ethernet cards plus four built-in 1 Gb/sec Ethernet ports; Total of 12 connections (12 Gb/sec total)
TCP/IP Management Ports	One 1 Gb Ethernet management port One serial management port
Fibre Channel Connections	Four 4 Gb dual-port FC cards (Eight 4 Gb FC ports)

Summary of Observations and Findings

The following sections summarize the data captured during the NetBackup proof of concept testing and include observations and conclusions drawn based on subsequent analysis.

Initial Comparison: Sun SPARC Enterprise M5000/T5220 Servers

Sun SPARC Enterprise M5000 and T5220 servers were compared for use as the NetBackup media server in the test environment. Both servers were connected via one 10 Gb Ethernet connection to form the LAN for initial testing. Both the Sun SPARC Enterprise M5000 and T5220 servers were able to meet the performance objective of backing up 5.3 TB of data in a 90 minute backup window. However, both media servers were constrained by the available network bandwidth and would benefit from additional networking bandwidth.

The cost of the media server, in terms of $/MB/sec, was an additional key factor in choosing the reference architecture media server hardware. A comparison of the Sun SPARC Enterprise M5000 and T5220 servers initially tested is included in Table 9.

Table 9. Initial testing of NetBackup media server performance.

	Sun SPARC Enterprise M5000 Server	Sun SPARC Enterprise T5220 Server
Number of tape drives	10	10
Sustained throughput	940 MB/sec	940 MB/sec
$/MB/sec (media server)	$195/MB/sec	$65/MB/sec
CPU utilization	40%	25%

The price/performance metric analysis was based on the following assumptions:

- The list price[1] of the Sun SPARC Enterprise M5000 server with the tested configuration was approximately $184,343.21. This price included all processors, memory, and all networking cards required for the test.
- The list price of the Sun SPARC Enterprise T5220 server with the tested configuration was approximately $63,589.12. This price included all processors, memory, and all networking cards required for the test.

The Sun SPARC Enterprise M5000 server has a series of capabilities that make it better suited to large enterprise workloads. For example, it includes electronically isolated domains, some of the most advanced RAS features in the industry, very high single thread performance as well as multi-thread throughput, greater I/O expansion capabilities, and the ability to mix multiple processor generations in the same chassis.

1. The list prices were in effect at the time the performance test was conducted. This document is not a guarantee of pricing, and the current pricing of the server hardware may vary.

Accordingly, the Sun SPARC Enterprise M5000 server had a higher cost per MB/sec than the SPARC Enterprise T5220 server. These initial results eliminated the Sun SPARC Enterprise M5000 server from further testing due to time and pricing constraints. Further testing explored various configurations of just the Sun SPARC Enterprise T5220 server for use as a NetBackup media server.

Further Testing: Sun SPARC Enterprise T5220 Server Configurations

Three configurations of the Sun SPARC Enterprise T5220 server, differing only in LAN connectivity, were evaluated. Results of this evaluation are included in Table 10. The earlier results from the testing with the Sun SPARC Enterprise M5000 server are included for comparison.

Table 10. NetBackup media server performance.

		Sun SPARC Enterprise T5220 server		
	Sun SPARC Enterprise M5000 Server	Config. A (1x10Gb XAUI)	Config. B (2x10Gb XAUI)	Config. C (12x1Gb)
Number of tape drives	10	10	16	10
Sustained throughput	940 MB/sec	940 MB/sec	1700 MB/sec	1120 MB/sec
$/MB/sec (media server)	$195/MB/sec	$65/MB/sec	$37/MB/sec	$55/MB/sec
CPU utilization	40%	25%	40%	40%

The Sun SPARC Enterprise T5220 server using two 10 Gb XAUI Ethernet interfaces (Configuration B) was the best performing backup solution, moving the 5.3 TB of data in 43 minutes (including the mounting of devices) with 40% CPU utilization. The next best performing configuration was the Sun SPARC Enterprise T5220 server using twelve 1 Gb/second Ethernet ports (Configuration C); this configuration was able to backup the 5.3 TB of data in 1 hour and 18 minutes. At $37/MB/sec, the Sun SPARC Enterprise T5220 server configured with two 10 Gb/second interfaces (Configuration B) was the best value.

The performance results for the tested media server configurations are depicted graphically in Figure 12.

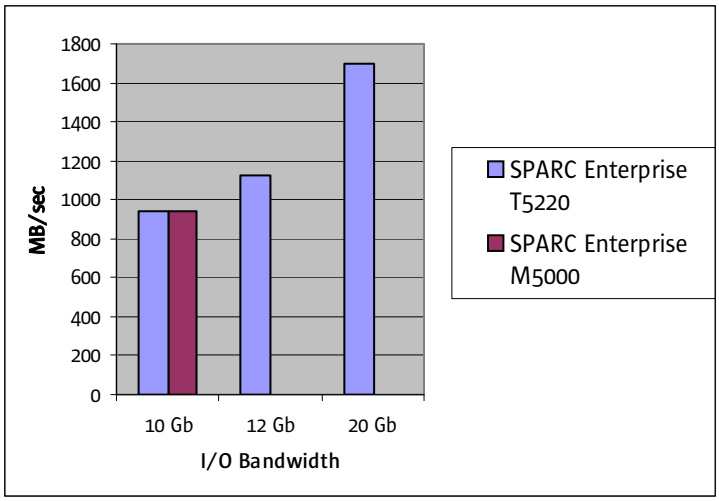

Figure 12. NetBackup throughput for tested media server configurations.

Tuning and Sizing Recommendations

This solution requires tuning to the Solaris 10 08/07 OS to allow the XAUI cards enough resources to drive the LAN at over 90% efficiency. The Symantec NetbackUp 6.5.2 software also requires tuning and the establishment of policies and separate data streams for faster networked clients and those that are slower to enable the tape drives to achieve maximum performance.

NetBackup LAN media servers, as used in this reference architecture, are suitable for use with clients that have less than 500 GB of data to back up. For clients with more than 500 GB of data, SAN media servers should be used. A NetBackup SAN media server would replace the two PCIe Ethernet HBAs with additional dual port 4 Gb/second Fibre Channel HBAs.

This basic architecture can be extended to meet the needs of large environments with more extensive backup requirements. Additional media servers can be added to help ensure that scheduled backups always have available media servers. Alternatively, one or more SAN media servers can be added to provide greater backup throughput for clients with large data storage. Each NetBackup domain, consisting of a master server and its associated media servers, can handle up to 2500 clients with 1 Gb network connections under optimum conditions, provided there are enough tape drives and sufficient network bandwidth for the clients. Very large networks can have more than one NetBackup domain, providing virtually unlimited scalability.

In situations where a lack of either LAN or SAN bandwidth occurs, a virtual tape library or staging disks can be utilized to mitigate the bandwidth limitations. In addition, total backup performance can be improved by using data deduplication functionality, available from a number of vendors, to reduce the amount of data being sent to backup by up to 80 percent.

Testing Conclusions

The Sun SPARC Enterprise T5220 server, configured with two XAUI 10 Gb Ethernet NICs (Configuration B), was the fastest and most efficient solution tested. Using pricing valid at the time of testing, this solution was determined to cost $37/MB/second for the media server.

The Sun SPARC Enterprise T5220 server as tested included one 1.4 Ghz UltraSPARC64 T2 processor, 64 GB of memory, two XAUI 10 Gb Ethernet NICs and four 4 Gb dual-port FC HBAs. This configuration was capable of driving sixteen StorageTek T10000 tape drives at maximum speed, and backing up 7.4 TB of data per hour from a heterogeneous client environment with both 100 Mb and 1 Gb Ethernet connections.

Chapter 5
Summary

The Sun reference architecture for next-generation data backup, powered by the Sun SPARC Enterprise T5220 server and using Symantec NetBackup 6.5.2 software, provides an excellent backup solution for large heterogeneous networks. The NetBackup software provides a comprehensive end-to-end data archive solution, with centralized management for simplified administration. Deploying a Sun SPARC Enterprise T5220 server as the NetBackup media server provides a powerful and cost-effective backup platform.

This reference architecture features a highly flexible architecture with virtually unlimited scalability. Although the configuration described in this document contains a single NetBackup media server, the generic NetBackup architecture supports multiple media servers working together under the administrative control of a master server. Additional media servers can be deployed or multiple backup domains can be configured to address evolving scalability requirements. Using Sun SPARC Enterprise servers and the Symantec NetBackup software, companies can implement cost-effective and powerful backup solutions for the largest, most diverse environments.

About the Author

Jason Ehrhart joined Sun in 1998 as a Technology Evangelist, eventually becoming a Technology Evangelism Manager. He then worked as a Solution Architect for the Sun|Netscape Alliance and is one of Sun's Principal Engineers. He is currently a Principal Architect for the Financial Services Vertical at Sun.

Jason has 26 years of experience in the high tech industry. Prior to his work at Sun, he worked at Netscape, Univel/Novell, Evans & Sutherland, Mips, Acer/Counterpoint, Elxsi, and Sperry/Unisys. Jason received his BS in Computer Science from the University of Utah and the US Coast Guard Academy. He lives with his wife and son on a mountainside above Salt Lake City, Utah.

Related Resources

- Symantec NetBackup software:
  `http://www.sun.com/netbackup/`
- Symantec NetBackup 6.0 documentation
  `http://docs.sun.com/app/docs/coll/veritas-netbackup6.0`
- Sun SPARC Enterprise T5220 server:
  `http://www.sun.com/servers/coolthreads/t5220/`

- Solaris OS internals tuning:
  `http://www.solarisinternals.com/wiki/index.php/Networks`
  `http://blogs.sun.com/puresee/entry/10_gigabit_ethernet_on_ultrasparc`

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