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Guide to the **ULTAMUS™ RAID Architecture**



ULTAMUS RAID 1200 Storage and Expansion Arrays

Overland Storage introduces ULTAMUS RAID, the next generation of RAID storage. The architecture underlying ULTAMUS RAID couples the industry's most advanced technology with comprehensive data protection, high performance and powerful, intuitive management. Overland's technological leadership translates into investment protection for storage buyers by minimizing the risk of obsolescence. ULTAMUS RAID arms storage managers with the tools they need to implement storage strategies and build IT infrastructures that align with both today's and tomorrow's business and data management needs.

The SAN Market is Reaching Maturity

This is a pivotal time for the storage industry. The technologies and the business drivers of Storage Area Networks (SAN) are changing. SAN fabrics (Fibre Channel, Ethernet) are constantly evolving. The underlying disk technologies (Fibre Channel, SAS, SATA II) are changing – all while storage applications are evolving (D2D, VTL, ILM and CAS) to meet new business requirements:

- SAN host connectivity
 - Fibre Channel – 2 Gb/sec migrates to 4 Gb/sec
 - iSCSI – becomes a standard on key platforms (Microsoft Windows®, Linux, Solaris, HP-UX, AIX)
 - SAS – replaces SCSI and FC disk drives
 - SATA II becomes the de-facto standard for capacity storage
- Growth in the entry markets
 - IDC Price Band 1 (\$1-\$4999) 32.2% CAGR (2006-2009)
 - IDC Price Band 2 (\$5000-\$9999) 26.2% CAGR (2006-2009)
 - IDC Price Band 3 (\$10,000-\$14,999) 18.1% CAGR (2006-2009)
 - IDC Price Band 4 (\$15-000-\$49,999) 6.9% CAGR (2006-2009)
- Disk drive technology
 - Fibre Channel - 2 Gb/sec migrates to 4 Gb/sec
 - SAS – replaces SCSI in the mid-market and challenges FC in the SMB/SME
 - SATA II – replaces SATA I and becomes a reliable enterprise disk platform
- Enterprise features move downstream
 - Management - "single pane of glass" for all RAID
 - Multi-pathing solutions – comprehensive data integrity
 - Snapshots – point-in-time backups and replication
 - Active-active fail-over for RAID controllers
 - Enterprise class performance and protection
 - Tiered storage strategies to support regulatory and business needs

Examining the key changes in the SAN storage market space first leads us to changes in host-to-storage interconnect technology. Figure 1 illustrates the leading and dominant role played by Fibre Channel (FC) in SAN infrastructures. This dominance is expected to continue for years to come. The installed base of FC and the straight forward, backward-compatible migration path (1 Gb/sec - 2 Gb/sec - 4 Gb/sec - 8 Gb/sec – 10 Gb/sec) will keep it on the SAN scene through at least 2009. SCSI will give way to SAS as the dominant DAS (Direct Attach Storage) connection while FC disk drives start ceding some of their dominance in business-critical application RAID storage to SAS over the next 2 years. iSCSI also gains prominence as storage IT managers implement lower cost connections to the SAN for all servers and as multi-Gb/sec solutions come to market, including port-bonded and 10 GbE products.

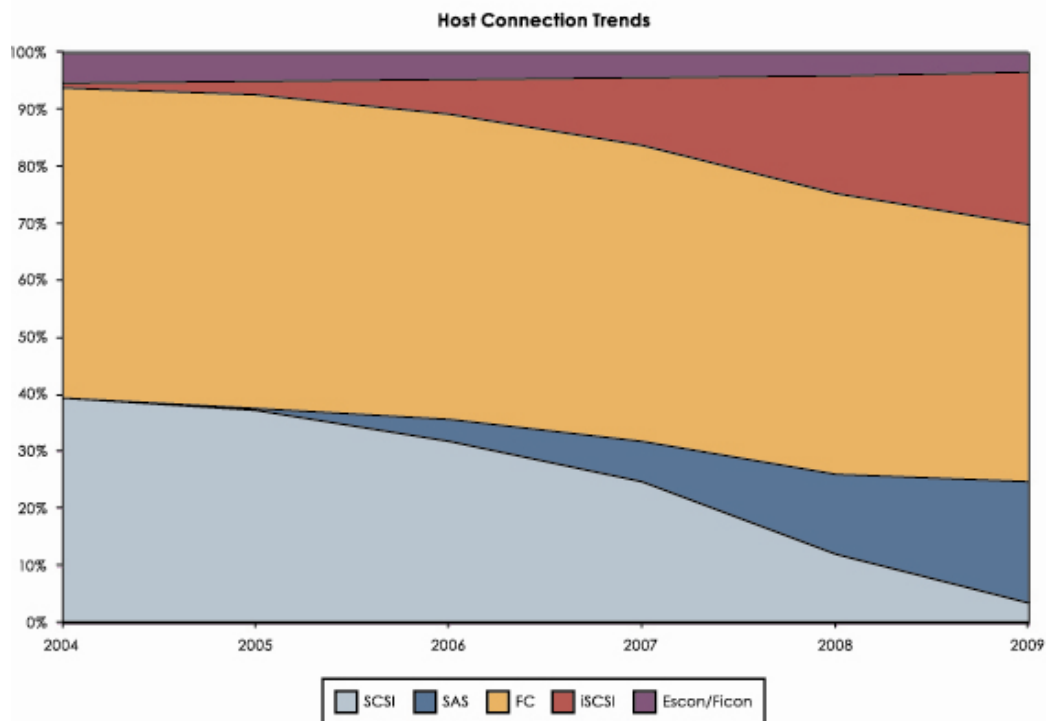


Figure 1. The Evolution of Host-To-Storage Interconnects

New Rules, New Reasons

The past few years have seen significant change in how and why data is stored. Beyond the obvious need to support the growing appetite of business applications, the business dynamics and requirements for on-line and near-line data storage have also changed. The continued growth of the web and interlinked application structures that demand online access and protection of data contribute to this growth. Worldwide regulations and government mandates have further affected data retention and access policies and the raw growth of new data are driving the adoption of a new generation of storage and SAN technologies.

- New Business Dynamics** – Storage capacity continues to grow from 60-100% per year depending upon who your favorite industry prognosticator may be. It is undeniable that storage capacity has to keep pace with the growing numbers of on-line transactions, e-mails, instant messages, RFID tags and other data-generating applications. And while the volume of newly-created data is exploding, the number of data copies that are stored to meet regulatory requirements, business continuance demands and the data access demands of customers increases.
- The Web and Interlinked Systems** – We have become accustomed to getting a data “fix” – 7 x 24 - for personal or business purposes. Data has to be online to link supply chains, perform online transactions and search for new music or streaming video. This not only requires vast quantities of data to be on-line, it requires that data be held in a “reference-able” or near-line state. Near-line or reference-able data not only needs to be constantly accessible and searchable it needs to be protected as enterprise mission critical data.
- Compliance with Regulatory Requirements** – Around the world, government regulatory requirements are changing and these changes lead to greater demand for data to be online and rapidly accessible. The data specified in a wide range of U.S. and international regulations must be tracked, protected and secured with accessibility requirements defined as well. Among the regulations affecting data storage and protection are: SEC 17a-4, GDPdU and GoBS (Germany), Electronic Ledger Storage Law (Japan), HIPAA, FDA 21 CFR Part 11 11MEDIS-DC (Japan), ISO

18501/18509, BSI PD0008 (UK), NFZ 42-013 (France), Canadian Uniform Electronic Evidence Act, AIPA (Italy), Sarbanes-Oxley Act, PRO Government Standard (UK), European Union Regulations on Personal Data Processing and others.

- **Business Continuance** – Mother Nature continues to remind us that there are many things that are simply beyond our control. Ensuring that business continues without interruption is a leading priority for IT organizations worldwide. The requirements of business continuity have led to an increased use of disk-based, remote data replication as well as a groundswell in the use of disk instead of tape for backup and instantaneous recovery.
- **Business Value** – Every industry has benchmarks for competitiveness and performance. Information technology often takes a leading role in achieving industry-leading performance and competitiveness by improving supply chain logistics, customer service and employee productivity. Any business process that can be performed faster and at lower cost is desirable. The business-based bottom line is almost always the motivation behind a move to a next-generation technology.

ULTAMUS RAID harnesses today's most advanced storage technologies to create a SMB/SME RAID solution that:

- Delivers a rich feature set
- Offers differentiated technology at a commodity price point
- Provides investment protection for storage managers
- Creates a new class of end-to-end performance in the entry-space market
- Provides a complete tiered storage strategy (ULTAMUS RAID with both SAS and SATA II drives; REO™ disk-based appliances; NEO™ and ARCvault™ tape automation products)

ULTAMUS RAID offers industry-leading features including:

Technology	Benefits	Overland Leadership
RAID 6 Hardware accelerated	<ul style="list-style-type: none"> • Higher availability 	<ul style="list-style-type: none"> • Better for mission-critical application availability • Overland's hardware-accelerated RAID 6 allows storage to remain online in the event of two drives failing simultaneously.
SAS drives	<ul style="list-style-type: none"> • Higher Performance • Lower Costs • Investment Protection • Higher Availability 	<ul style="list-style-type: none"> • Ideal for email, web serving, database and other performance-intensive applications. • Provides the performance and reliability of Fibre Channel drives at 30% lower cost. • SAS and SATA II drives can be combined in the same RAID chassis to support applications with vastly different capacity and performance requirements.
Enterprise SATA II drives	<ul style="list-style-type: none"> • Higher availability • Higher performance • Better price/TB • Investment protection 	<ul style="list-style-type: none"> • Better performance for D2D backup and media • Built for 7 x 24 operating environments • Fewer drive timeouts and fewer RAID rebuilds • 1.4 million hour MTBF at 100% duty cycle – more than double the reliability of desktop SATA II drives • Directed Offline Scan (DOS) monitors every write and performs diagnostic tests when drives are idle, enhancing data availability. • Perpendicular Recording reduces the number of moving parts, for higher availability • Protection against technological obsolescence
SAS expansion and scalability	<ul style="list-style-type: none"> • Grows with your application requirements 	<ul style="list-style-type: none"> • Effortlessly scales up to 60 drives in 12 drive, 2U increments • No performance penalty
4 Gb/sec Fibre Channel	<ul style="list-style-type: none"> • Higher performance • Investment protection 	<ul style="list-style-type: none"> • Better performance for all applications. • 4 Gb/sec FC improves IOPS-intensive application performance with reduced latency and improves streaming application performance with higher data transfer rates.
Snapshots	<ul style="list-style-type: none"> • DR and data protection 	<ul style="list-style-type: none"> • Snapshot technology offer the best value in data protection by creating low-impact copies of data that support point-in-time recovery.
Pricing	<ul style="list-style-type: none"> • Low acquisition cost 	<ul style="list-style-type: none"> • Excellent price/TB for RAID storage • Integrated RAID ASIC technology reduces controller costs and an optimized supply chain reduces platform costs.

ULTAMUS RAID Application Benefits

ULTAMUS RAID is the right platform to make IT applications run faster, with higher availability and improved ROI.

Applications	ULTAMUS Features	Business Benefit
<ul style="list-style-type: none"> Database E-Mail Web Servers 	<ul style="list-style-type: none"> Multi-pathing for key OSs 4 Gb/sec host connection provides high data transfer rates and low latency SAS drives provide maximum IOPS (based on 15K RPM) at a lower cost than 4GB FC drives Hardware accelerated RAID 6 improves data availability 	<ul style="list-style-type: none"> More transactions Lower cost per IOP Improved operations and lower management cost with higher availability
<ul style="list-style-type: none"> Video D2D Backup 	<ul style="list-style-type: none"> Multi-pathing for key OSs 4 Gb/sec host connection provides more consistent data transfers for streaming applications SATA II drives offer the right performance with very high capacities Hardware accelerated RAID 6 improves data availability 	<ul style="list-style-type: none"> More data protected online for regulatory requirements Improved cost per TB Improved operations and lower management cost with higher availability
<ul style="list-style-type: none"> Tiered Storage 	<ul style="list-style-type: none"> Multi-pathing for key OSs Shared SAS/SATA II architecture allows for optimizing cost, performance, capacity, and access requirements Single box, many uses Snapshots provide efficient data protection on the right class of storage 	<ul style="list-style-type: none"> Investment protection, asset management, and flexibility Lower cost per IOPs and TB Improved operations and lower management cost with higher availability

The Ascent of Tiered Storage

Storage managers balance the business requirements and technical issues of explosive data growth against the daunting budget realities of keeping more and more data online. Tiered storage has been around using different aliases for years. But tiered storage infrastructures are now being deployed to meet growing business and regulatory demands. Tiered storage architectures focus on three key business dimensions:

- Lowering the cost of near-line storage
- Protecting data in all storage tiers in the hierarchy
- Supporting the access control and policy requirements needed to satisfy business & regulatory needs

Storage Tier	Storage Model	Role of Near-Line Storage in Tiered Storage Architectures
Mission-critical	Enterprise RAID	<ul style="list-style-type: none"> Store more with lower costs for online backup Repository for replication data
Business-critical	RAID	<ul style="list-style-type: none"> Store more with lower costs for online backup Repository for replication data
Departmental	Low cost SAN, Low cost NAS, New SAS-based DAS	<ul style="list-style-type: none"> Store more with lower costs for online backup Repository for replication data
Near-line	Low cost SAN based on SATA II RAID	<ul style="list-style-type: none"> Provide near-line access at a lower cost /TB Meet access demands for business/regulatory needs Repository for replication data
Backup	VTL based on low cost SATA	<ul style="list-style-type: none"> Disk-based backup versus tape Meets access time demands Data compression and reduction
Archive	Tape (offsite)	<ul style="list-style-type: none"> Offsite tape is still the last line of defense for data protection

ULTAMUS RAID – The Right Platform for Data Storage & Protection

Evolving technology can lead to great opportunity. As storage managers work to understand and then embrace the right solutions for their needs, Overland Storage has worked to build a storage platform that meets the growing and demanding storage needs they face every day.

In this section we examine the key components and technologies that underlie ULTAMUS RAID:

- ULTAMUS RAID architecture: fully redundant, highly available
- ULTAMUS RAID Storage Processor
 - The RAID core
 - Integration for performance and cost containment
- RAID controller – sustains high IOPS and data rates while expanding the range of protection options
 - Host interfaces, RAID levels, cache, chassis
 - Management ports
- Data management software
 - Snapshot
 - Point in time data presentation to backup software
- Enclosure – high availability mechanical architecture
 - Frame and mid-plane
 - Base RAID and expansion JBODs
 - Power and cooling
- System management
 - External status monitoring
 - Management GUI
 - Support for industry standards
- Agency and regulatory
 - Agencies
 - RoHS and WEEE

ULTAMUS RAID Architecture: Fully Redundant, Highly Available

ULTAMUS RAID employs a fully redundant architecture that is designed for high availability in the most demanding IT environments. Figure 2 illustrates the high level architecture.

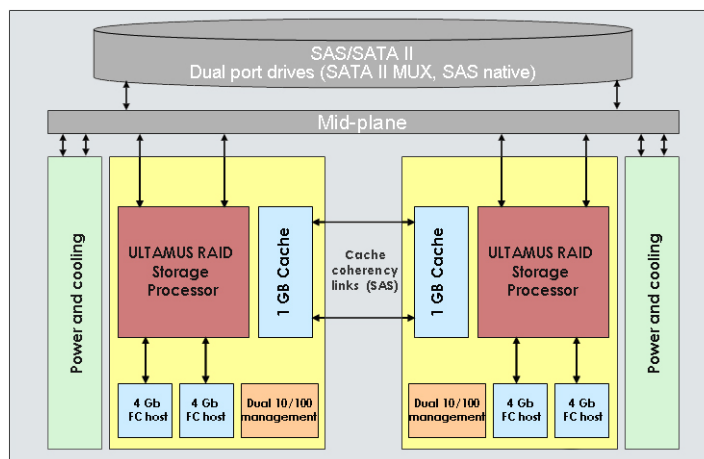


Figure 2. ULTAMUS RAID High Level Architecture

ULTAMUS RAID Storage Processor

At the core of the RAID architecture is the ULTAMUS RAID Storage Processor. This ASIC (Application Specific Integrated Circuit) is designed to provide flexible, low cost and high performance RAID processing power for the system. As the heart of the RAID controller, the ULTAMUS RAID storage processor delivers five (5) key features and characteristics:

- **Hardware Accelerated RAID** – The ULTAMUS RAID storage processor is the foundation of the ULTAMUS RAID architecture. The storage processor performs the parity calculations required to protect and rebuild RAID sets in the event of drive or other failure. The ULTAMUS RAID storage processor ASIC accelerates parity calculations in silicon for all RAID levels, including RAID 6. RAID 6 provides the ability to recover from 2 drive failures in the same RAID set. Because of dual drive failure protection, RAID 6 requires twice as many parity calculations as RAID 5 when writing data. This level of parity calculation can stress competing products, many of which perform RAID 6 parity calculations using a general-purpose processor and software. The ULTAMUS RAID storage processor delivers the performance needed to support RAID 6 with a write performance penalty typically under 10% when compared to RAID 5 while delivering dual drive failure protection.
- **High Performance IOPS** – RAID systems are designed to safely and efficiently move data between host interfaces and disk drives. The first of two key performance ratings is the number of Input/Output Operations per Second (IOPS). High IOPS require an efficient, low latency RAID core that is capable of moving commands and data from the host through the cache and to the disk drives rapidly. The ULTAMUS RAID storage processor delivers up to over 40K IOPS (80K in dual controller configurations). This level of performance is essential for transaction based applications such as databases, email and web serving. Replacing older storage with ULTAMUS RAID can improve applications performance immediately by enabling existing applications to process more transactions.
- **High Performance Sustained Data Rate** – the second key performance rating is the sustained data transfer rate (MB/second). The ULTAMUS RAID storage processor provides the ability to tune the size and configurations of the cache to support applications that are data transfer rate sensitive. Video, HDTV, data capture, media streaming, backup, scientific and research applications will find that ULTAMUS RAID is an ideal storage platform. The ULTAMUS RAID storage processor delivers up to 380 MB/sec (760MB/sec in dual controller configurations).
- **Integrated Cost Savings** – The ULTAMUS RAID storage processor incorporates a SAS/SATA controller that provides higher performance at less cost by reducing the number of chips on the controller board and latency between the chips.
- **Designed for Flexibility** – The ULTAMUS RAID storage processor supports a variety of host and disk drive interfaces. The core ASIC supports 4 Gb/sec FC on the host side and 3 Gb/sec SAS and SATA II on the drive side.

ULTAMUS RAID Controller

The ULTAMUS RAID controller, shown below, is based on the ULTAMUS RAID storage processor. It provides a complete active-active, high performance and high availability RAID solution for storage managers.

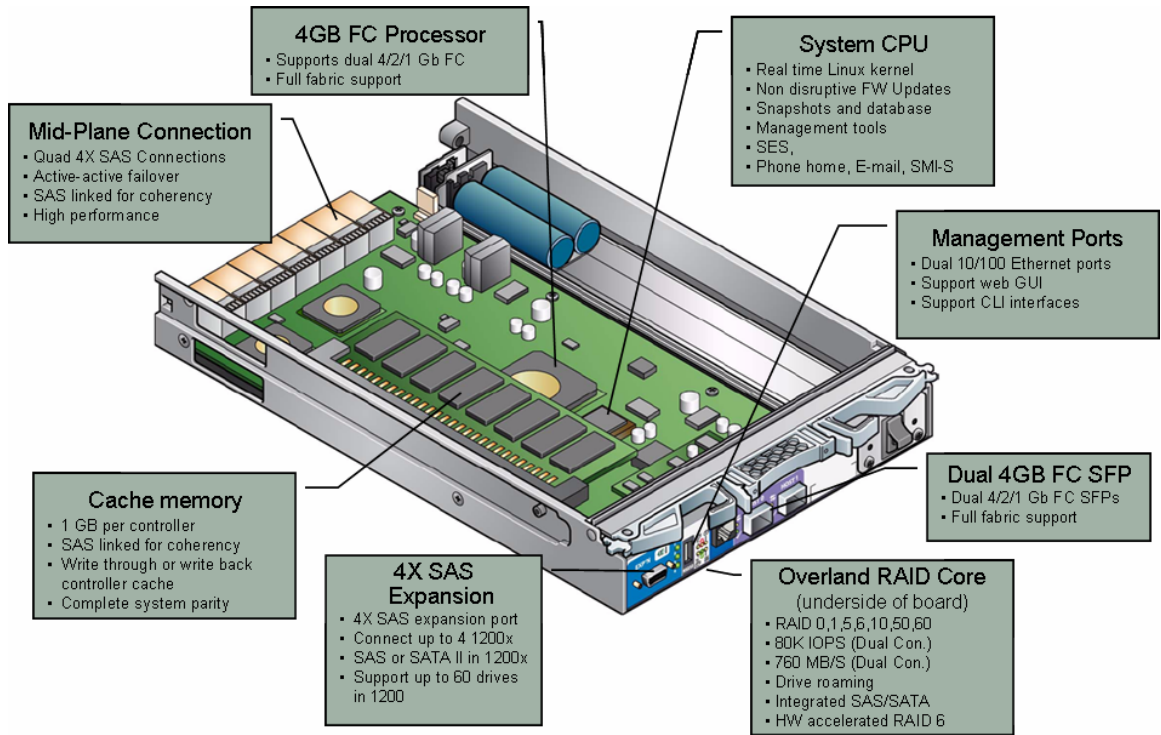


Figure 3. ULTAMUS RAID Controller

The ULTAMUS RAID controller provides features and capabilities that enable extensive scalability, connectivity, management and high availability. Among these features and capabilities are:

- **Active-Active Failover and Failback** – The ULTAMUS RAID controllers provide an active-active, dual data path architecture from hosts to storage. It supports failover and automated failback as well as dynamic load balancing.
- **Cache Coherency** – Cache on each controller is synchronized over a low-latency, dedicated 4X SAS connection that improves write performance in active-active mode while protecting data integrity.
- **Scalability** – Each ULTAMUS RAID controller has a 4X SAS connector for connecting to external expansion JBOD chassis (ULTAMUS RAID 1200x). This enables ULTAMUS RAID 1200 to support up to 60 SAS/SATA II drives with a total raw capacity of up to 45 TB (raw capacity) when using 750 GB SATA II drives.

Drive interface	Drive capacity (GB)	RAID 1200 base capacity (TB)	RAID 1200 max. capacity (TB)
SAS	146	1.7	8.76
SAS	300	3.6	18
SATA II	500	6	30
SATA II	750	9	45

- **Dual 4 Gb/sec FC Ports (SFP)** – ULTAMUS RAID ships with 2 x 4 Gb/sec FC ports per controller. Dual controller systems are equipped with 4 x 4 Gb/sec FC ports.
- **Management Ports** – ULTAMUS RAID supports management configurations via Ethernet connections or via RS-232 port. The systems support multiple management software options that include a web GUI or CLI.

Single RAID Controller SAS Architecture

As shown in Figure 4, ULTAMUS RAID employs a state-of-the-art SAS infrastructure throughout. SAS uses a serial, point-to-point interface in which disk drives are linked directly to RAID controllers, enabling systems with many drives to scale in bandwidth far beyond the capability of SCSI. To complement this bandwidth scalability, SAS expands the maximum number of devices to 16,384, well beyond the maximum number (16) that can exist in a parallel SCSI domain.

SAS offers a direct link from the RAID or JBOD controller to disk drives. In contrast, SCSI drives use a parallel interface in which drives share a common bus and compete for a portion of the available bandwidth.

SAS offers the ability to aggregate ports to form “wide ports” capable of supporting higher throughput. ULTAMUS RAID products employ SAS connectors (IN and OUT) in which 4 SAS ports are aggregated to yield a “wide port” with a bandwidth of 12.0 Gb/sec (1,200 MB/sec; 24.0Gbps or 2,400 MB/sec in full duplex mode). This produces a total bandwidth that ranges up to eight times (8X) that of an Ultra SCSI bus (320 MB/sec).

The SAS bandwidth advantage produces far more headroom for scaling application performance than enabled by traditional parallel SCSI.

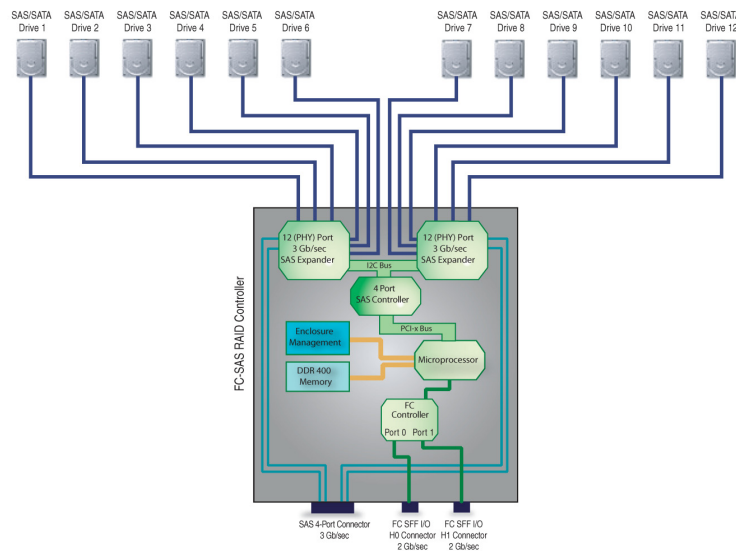


Figure 4. Single RAID Controller SAS Infrastructure

Dual RAID Controller SAS Architecture

In dual RAID controller configurations, ULTAMUS RAID exploits its SAS architecture not only for connectivity to disk drives and expansion JBOD chassis but also as a low latency, high bandwidth cache coherency link in dual controller active/active failover mode. Figure 5 highlights the use of inter-controller SAS links to provide low latency cache coherency.

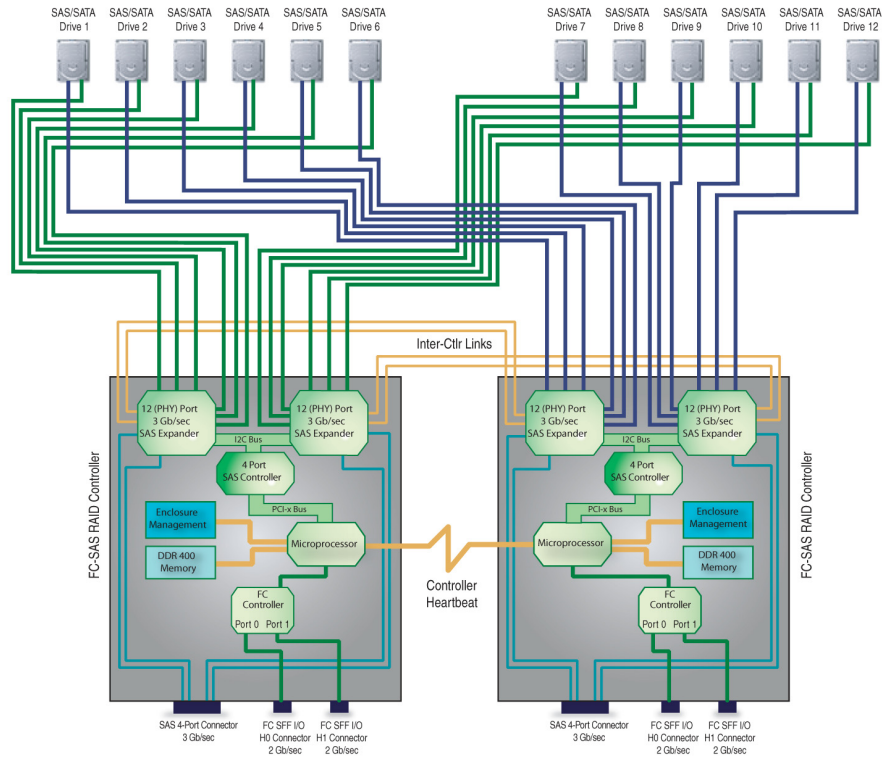


Figure 5. Dual RAID Controller SAS Infrastructure

Internal Monitoring, Statistics Collection & Performance Reporting

ULTAMUS RAID includes an embedded performance monitoring tool that scans commands and data transfer operations to produce real-time performance reports and statistics. Monitoring data and statistics are recorded for both reads and writes and can be used by the storage manager to tune the operating system and the I/O sub-system for optimum performance.

Details on how to best use the information collected and presented by the ULTAMUS RAID Manager are available in the Overland publication titled: **“ULTAMUS RAID Manager Users Guide”**.

The statistics monitored include:

- Read and Write Performance
- Command Count
- Command Alignment
- Command Size
- Read-Ahead Statistics
- Write Clustering Statistics
- Write Statistics

Each RAID controller maintains individual access information for all logical drives, controllers, and ports. This information may also be exported to a comma delimited file for use in third-party software products. Figure 6 below illustrates the basic statistical data tabulation screen.

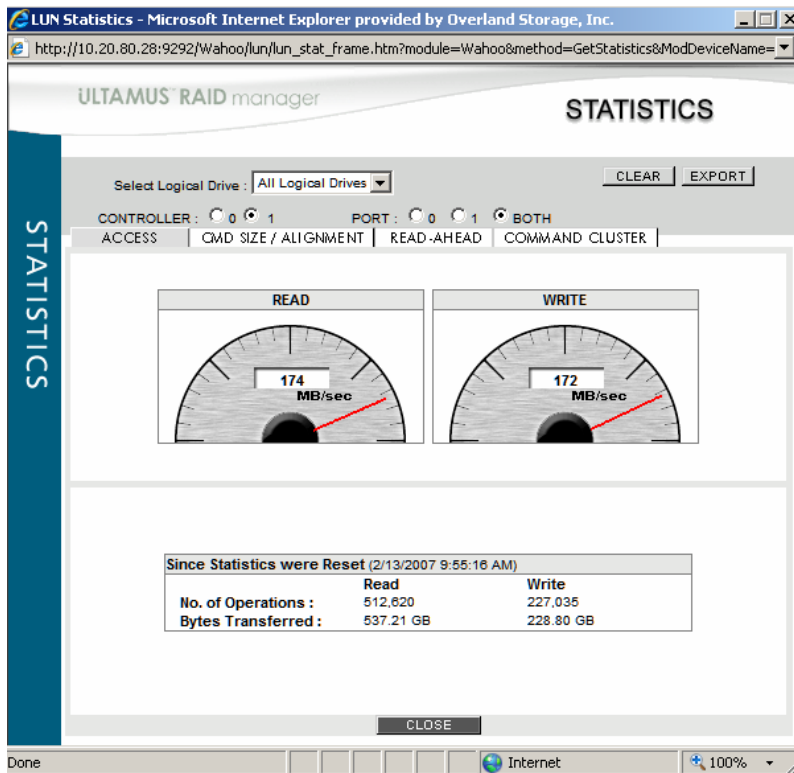


Figure 6. ULTAMUS RAID "Built In" Performance Monitor

Field Description

- Reads: The average number of megabytes of data transferred in the last few seconds from the logical drives, controllers or ports. This value is expressed in MB/second.
- Writes: The average number of megabytes transferred in the last few seconds to the logical drives, controllers or ports. This value is expressed in MB/seconds.
- Number of Operations: The total number of read and write accesses that have occurred since these statistics were reset, or the controller was last powered on.
- Bytes Transferred: The total number of bytes read and written since these statistics were reset, or the controller was last powered on.

Command Size and Alignment Statistics

Command size statistics express the percentage of commands whose size is as specified. The alignment statistic is the percentage of commands whose addresses aligned on the specified address boundary. For optimal performance, a write of one chunk of data should reside exactly within a chunk on one disk.

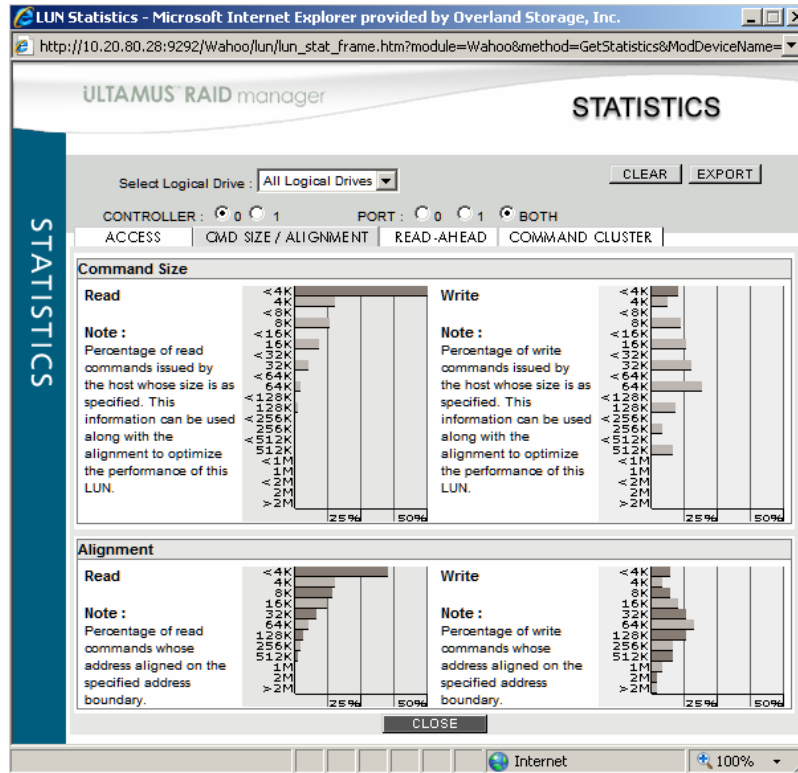


Figure 7. ULTAMUS RAID Command Size and Alignment Tab

Read-Ahead Statistics

When sequential read commands are sent to the RAID controller, it assumes that the commands which follow are also sequential. The RAID controller then reads ahead before the host requests the data. This improves performance, particularly for smaller reads. The size of the read-ahead is calculated based on the original command size, so the controller does not read too much data.

The controller maintains statistics for all read-ahead commands performed.

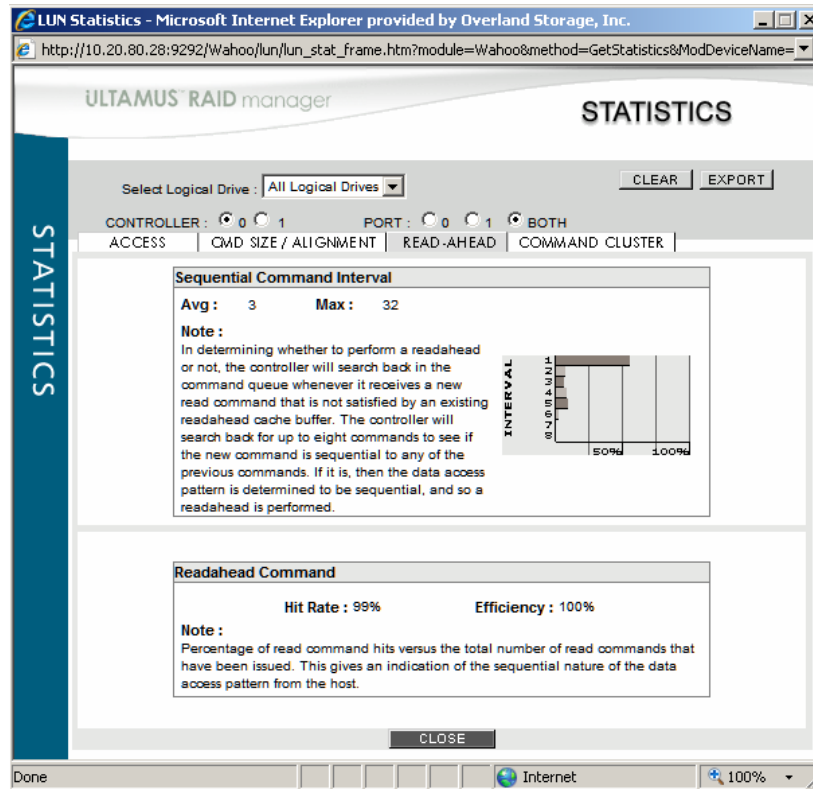


Figure 8. ULTAMUS RAID Read Ahead Tab

Command Cluster Statistics

To increase performance, the RAID controller aggregates (or "clusters") sequential write commands together to create a larger write command. This results in fewer commands being sent to the disk drives. Additionally, if sufficient data is aggregated by the controller, it can then perform a full stripe write which can significantly improve performance. In cases where the host does not issue a sufficient number of outstanding write commands, RAID controller writeback cache can be used to delay the write to disk, increasing the likelihood of aggregating more data.

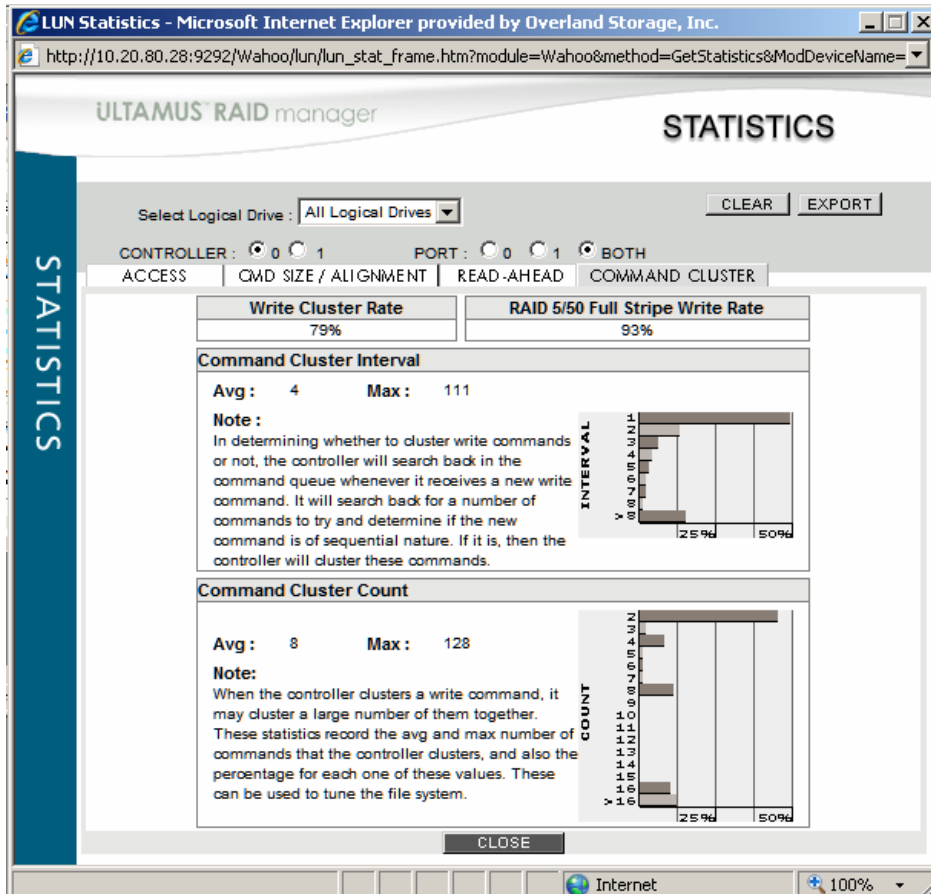


Figure 9. Command Cluster Tab

ULTAMUS RAID High Availability, Active/Active Failover and Failback

The growing reliance on databases, the Internet, e-commerce and other business-critical applications means that storage managers increasingly insist that RAID systems be available year round, 24 hours per day, seven days a week.

To understand the role of "path failover" in high availability environments, this discussion describes a "path". A path is the complete route from the application in the host to the controller, including the HBA, cabling and possibly a switch. A multi-path solution requires that there be more than one of these paths.

The number of paths is easy to see if direct connections are made (it is simply the number of physical cables), but less obvious if a switch is used.

If, for example, there are 4 HBAs connected to a pair of switches, and the switches are connected to both ports of two controllers, there will be a total of 8 paths as illustrated in Figure 10.

Multi-pathing is the use of multiple physical components (such as host bus adapters, cables and switches) to provide two or more data paths to a storage device and hence avoid a single point of failure. When a component in one path fails, a different path to the device will still be available for data transfer.

ULTAMUS RAID Path manager provides failover/failback functionality. For any given logical drive, I/O will only be sent down one path at a time. If the path becomes unavailable, I/O will switch to another path. If the previous path becomes available again, I/O will not switch back unless the previous path has been set as the preferred path.

ULTAMUS RAID Path manager provides failover/failback and preferred path features.

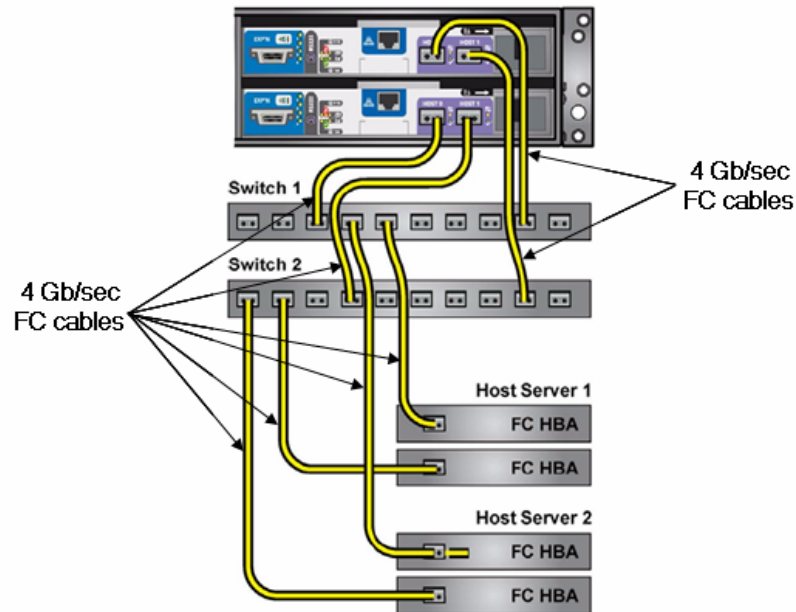
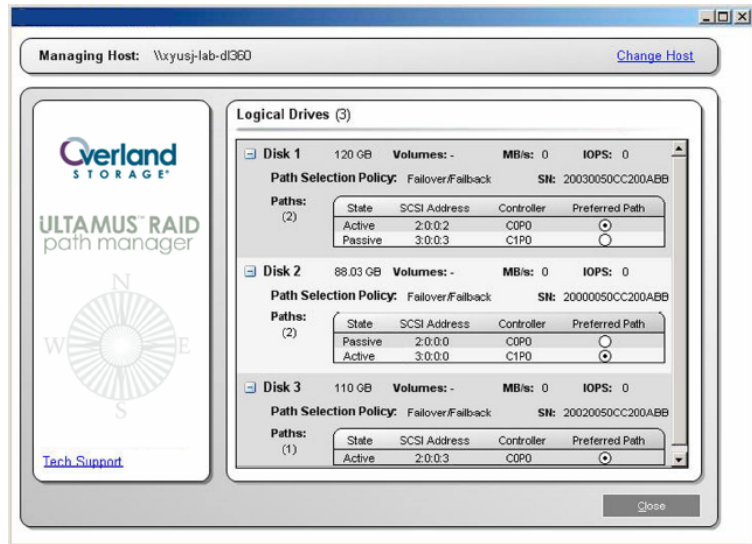


Figure 10. Failover Controller Cabling

ULTAMUS RAID Path Manager

Storage Area Networks (SANs) increase availability, enhance storage consolidation and decrease the risk of data loss to critical applications. ULTAMUS RAID path manager is Overland's multi-pathing solution for ULTAMUS RAID that provides fault tolerance against single-point-of failures in SANs and direct attached configurations.

ULTAMUS RAID path manager is designed to provide failover through the use of redundant physical path components—adapters, cables, and switches—between servers and ULTAMUS RAID products. In the event that one or more of these components fails, applications can still access their data.



ULTAMUS RAID path manager leverages operating system multi-pathing capabilities for easy to use and reliable application fail-over. ULTAMUS RAID path manager for Windows is based on Microsoft's MPIO and is a certified Device Specific Module (DSM) with an intuitive graphical user interface for designating alternate paths. ULTAMUS RAID path manager for Linux is based on native Linux Device Mapper. Multi-pathing with ULTAMUS RAID path manager operates in both single and clustered host configurations.

Data Management Software - ULTAMUS RAID Snapshot

ULTAMUS RAID snapshots feature an additional level of data protection and the means to improve production data utilization. Snapshot is designed for users whose data availability cannot be disrupted by routine management functions. Point-in-time images of logical drives are saved for near instantaneous roll-back of updates. Snapshot supports round-the-clock processing as it stages data for operations such as backup, data mining/analysis and work distribution.

Snapshot is especially useful in operations requiring a quick copy of data.

Snapshot images are fast and efficient, with essentially no disruption to the user. A momentary suspension of processing allows application data to synchronize to a known state preparing the snapshot volume for use.

A snapshot logical drive is a virtual point-in-time image of a source logical drive. It is the logical equivalent of a complete physical copy, but is created much more quickly and requires less disk space. Snapshot logical drives appear and function as standard logical drives. They are host addressable and can be read or copied to create a real copy of a point-in-time. Snapshot is an integral component of the ULTAMUS RAID code that runs in the RAID controller rather than on a host – maximizing performance while ensuring full availability to data as applications continue to process. Through its copy-on-write technology, snapshot preserves data in its original form in an "Overwrite Data Area". This functionality asks for minimal dedication of storage capacity, typically between 10 percent and 20 percent of source logical drive, enabling it to generate several snapshots within the space that would be required for a single mirror.

Fast recoveries to point-in-time versions of logical drives are accomplished via "snap-back" operations. A snap-back reverses all the updates made to all of the data stored on a source logical drive to the point-

in-time the snapshot was established. Users can quickly back-out erroneous changes and recover critical data.

As shown in Figure 11, ULTAMUS RAID snapshots employ a Copy-On-Write (COW) process meaning that the snapshot copy and the primary data share the same data source, except when new data is created. The snapshot keeps the unchanged file and the primary data keeps the updated file. It is important to note that a snapshot is not a complete physical replication of the original disk when it is created, only a virtual copy, as all data written to the source volume will still reside on the source disk.

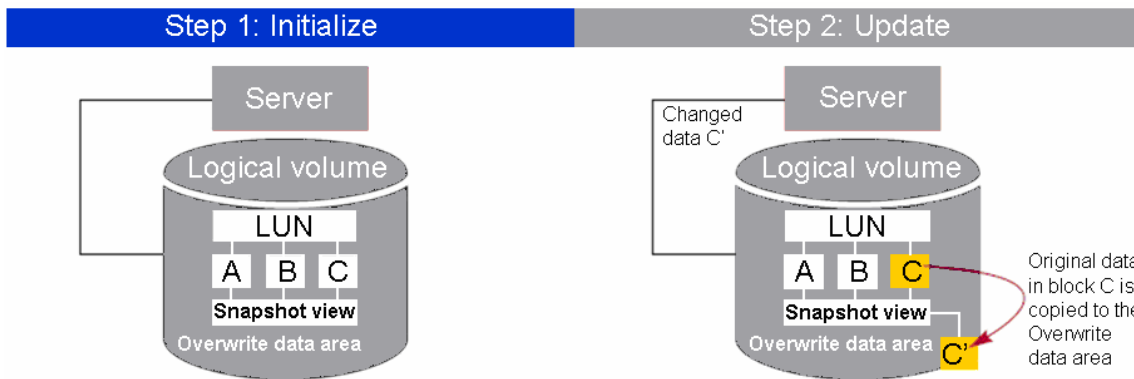


Figure 11. ULTAMUS RAID Copy On Write (COW) Snapshot

ULTAMUS RAID snapshots take place above the RAID functionality, enabling snapshots to benefit from the redundancy and error recovery of the RAID system. Different RAID levels may be used for the source and snapshot logical volumes. This snapshot architecture also enables snapshots of primary data stored on SAS disk drives to be maintained on logical volumes constructed from lower-cost SATA disk drives.

When in operation, servers continue to read from the source volume and write to a special reserved area with the user unaware that the snapshot has occurred. Once the snapshot is released and the source volume is "unfrozen", data that was written to the source volume while the snapshot was active is re-integrated into the source volume. This activity is transparent to the user.

ULTAMUS RAID snapshots produce a result similar to a full volume copy, but snapshots are captured in far less time – and require far less disk space - than would be required for a full volume copy. Once a snapshot is taken, a server writing to the source logical volume transparently causes pre-defined segments of the source logical volume to be copied to the snapshot before allowing the write to continue, thus preserving the original data on the snapshot. Another server can then be allowed to "view" (or mount) the frozen data. A backup server can mount the snapshot volume and backup the frozen data to a REO, NEO, ARCvault or other backup device while the application server continues in production. Using snapshots creates a backup environment that dramatically minimizes the impact on day-to-day operations.

ULTAMUS RAID 1200 Enclosure

Please refer to Figure 12 for the following discussion.

The ULTAMUS RAID 1200 chassis enables storage managers to build scalable and highly available solutions. All major components of the solution are redundant and hot swappable including:

- **Disk Drive Sleds** – The drive sleds are stand-alone components. That includes the SAS/SATA II notification LEDs, drive locks, dual-port dongles (for SATA II drives) and hot-swap connectors.
- **RAID Controllers** – Each RAID controller tray includes the controller board, FC SFPs, battery backup and management ports.
- **Power** – Each unit is equipped with dual 350W power supplies. A chassis can operate with just one functional. In the event of a failure, notification can be sent to the storage manager. Both power supplies are hot swap and have individual power connectors.
- **Rack Mounting** – The system can be rack mounted on rails.

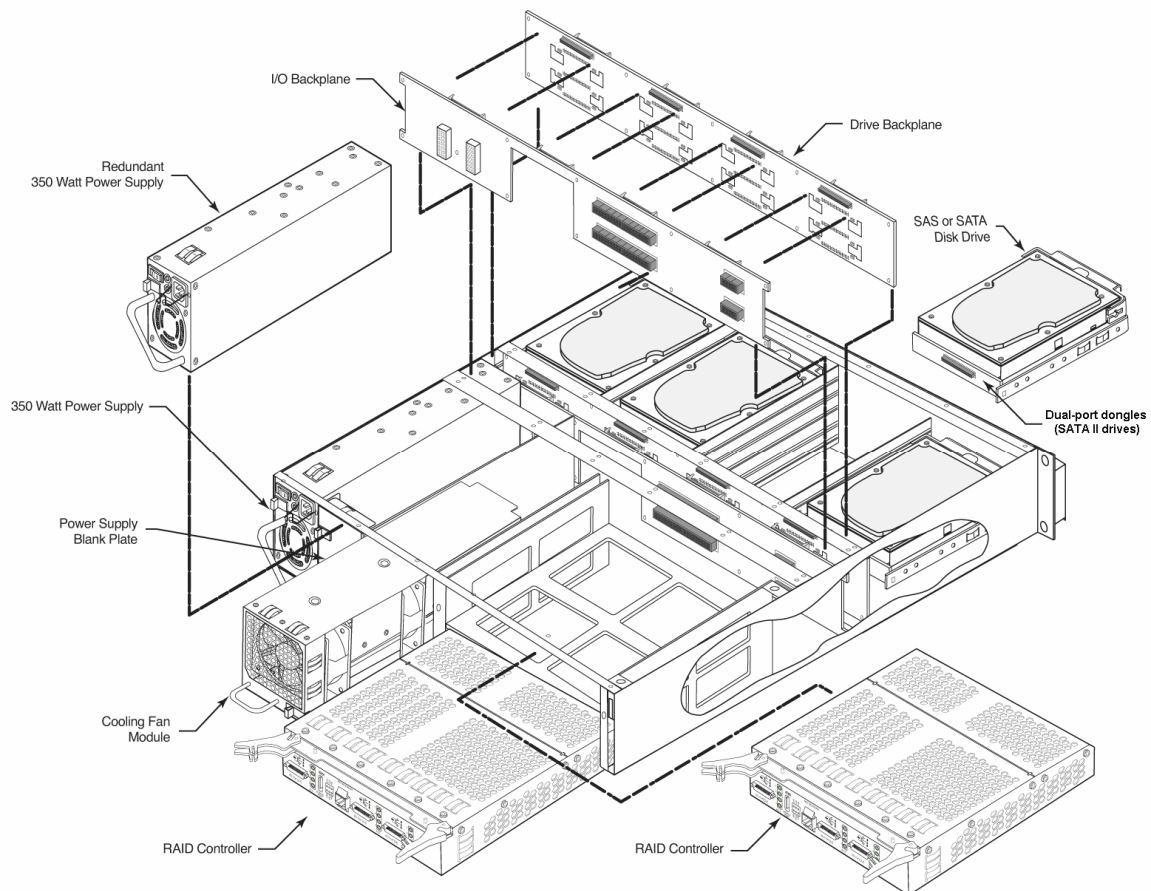


Figure 12. ULTAMUS RAID 1200 Enclosure

- **Airflow and Cooling** – The fan module house two fans, mounted in-line with one at each end of the fan module (please refer to Figure 13). The fans operate independently. In the event of the loss of one fan the remaining fan continues to operate, exhausting air from the interior of the unit. The system can operate with just one fan operational. In the event of a failure, notification is sent to the IT manager. The fan module is hot swap. In the event of a fan failure within the fan module, the module should not be removed until a replacement unit is at hand.

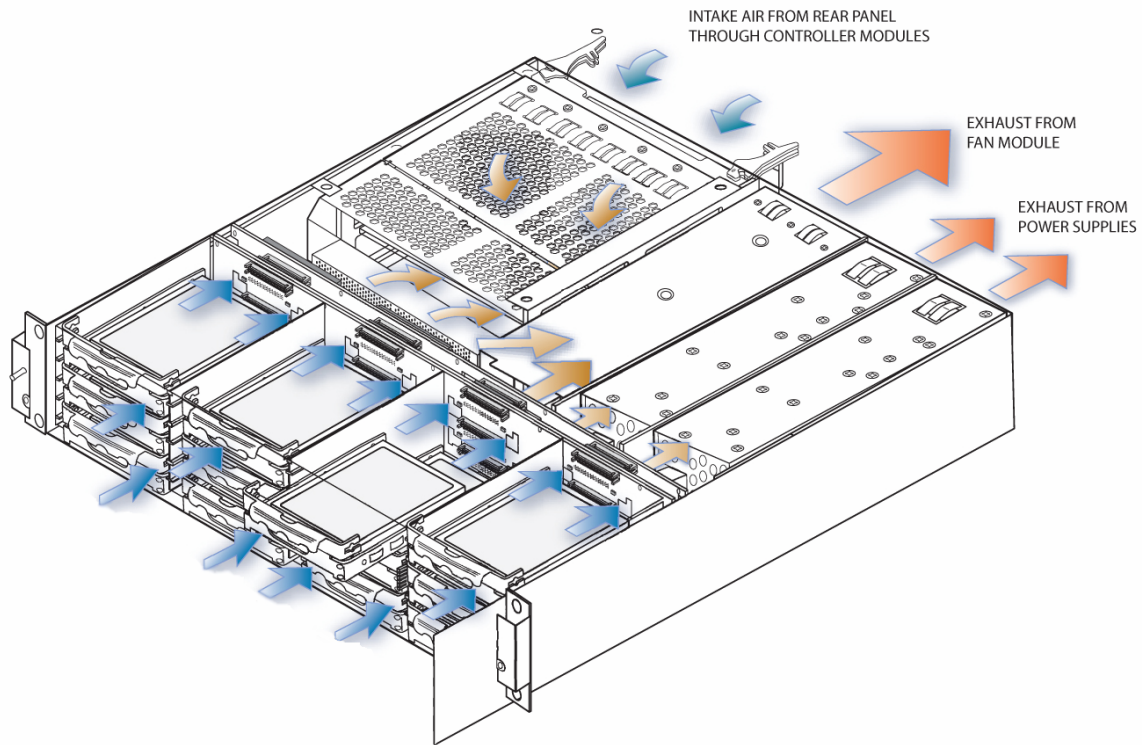


Figure 13. ULTAMUS RAID Airflow and Cooling

ULTAMUS RAID Capacity Expansion

ULTAMUS RAID 1200 can expand to a maximum of 60 drives (up to 45 TB of raw capacity when using 750 GB SATA II drives) through the addition of up to four (4) ULTAMUS RAID 1200x chassis configured as JBOD capacity expansion storage. JBOD capacity expansion storage features 2.4 Gb/sec 4x SAS “wide port” connectivity to the base RAID 1200 to grow capacity without sacrificing performance or increasing storage management complexity.

The external appearance of the front panel and mounting ears of the ULTAMUS RAID 1200x (expansion module) is identical to that of the ULTAMUS RAID 1200 with the exception of the Overland branding information.

The ULTAMUS RAID 1200 is equipped with 1 or 2 RAID controllers. Every accompanying expansion chassis (ULTAMUS RAID 1200x) is equipped with two JBOD controllers that connect the expansion chassis to the ULTAMUS RAID 1200 (base unit) chassis (see Figure 14).

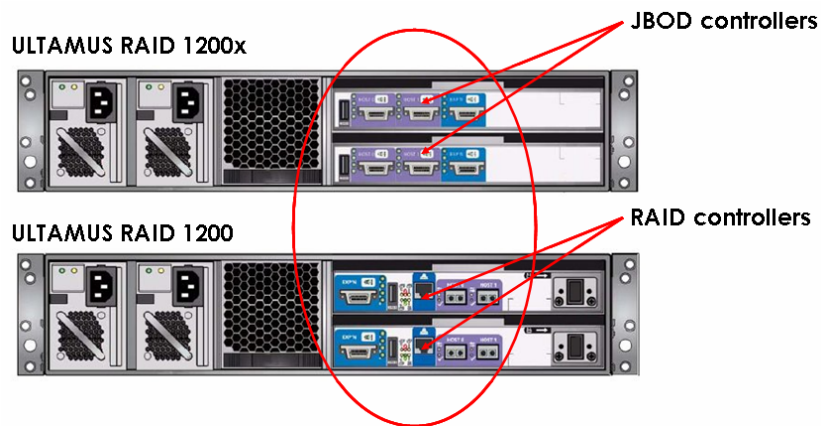


Figure 14. RAID and JBOD Controllers

ULTAMUS RAID 1200 capacity is achieved through the addition of ULTAMUS RAID 1200x expansion chassis as illustrated in Figure 15. The links between the ULTAMUS RAID 1200 chassis containing the RAID controller(s) are 4-lane wide SAS links with a bandwidth of 2.4 Gb/sec, ensuring that performance bottlenecks do not exist in the ULTAMUS RAID 1200 capacity expansion architecture.

It is through this strategy that the ULTAMUS RAID 1200 can expand to as many as 60 drives, or 45 TB of raw capacity (using 750 GB drives) without affecting performance.

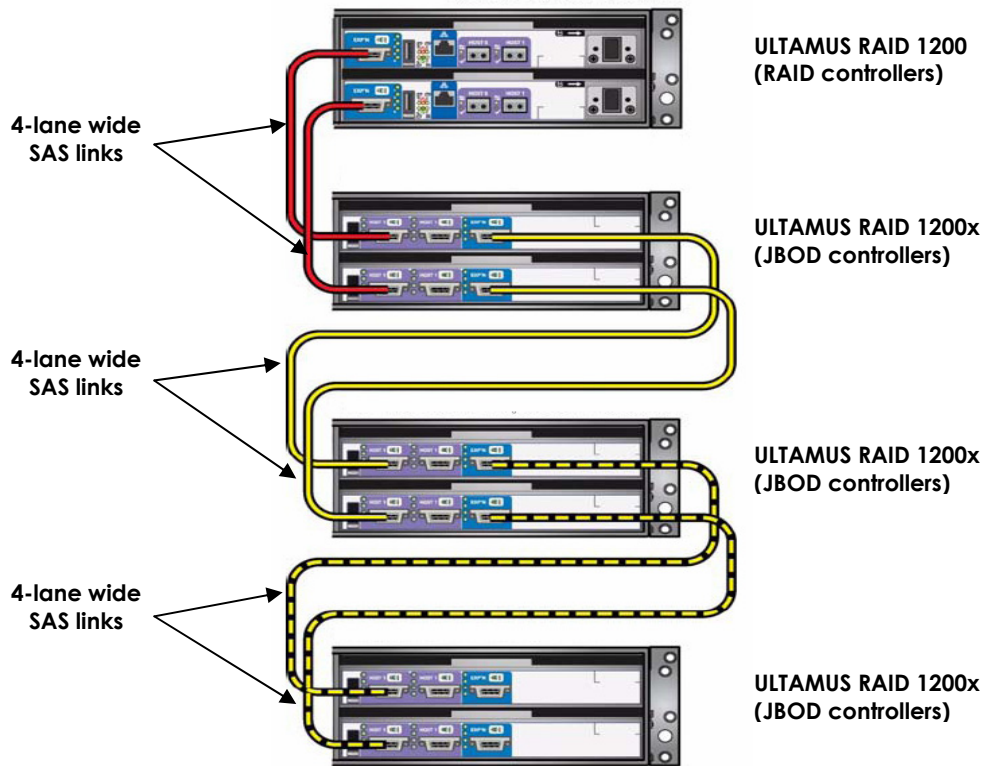


Figure 15. ULTAMUS RAID 1200 Scales to as Many as 45 TB Using 4-Lane Wide SAS Links

ULTAMUS RAID System Management

External Status Monitoring

Each ULTAMUS RAID enclosure is equipped with a status monitoring panel on the left mounting ear (Figure 16) that displays system status at a glance. Four (4) LEDs provide a visual indication of power and fault status as well as enclosure identity.

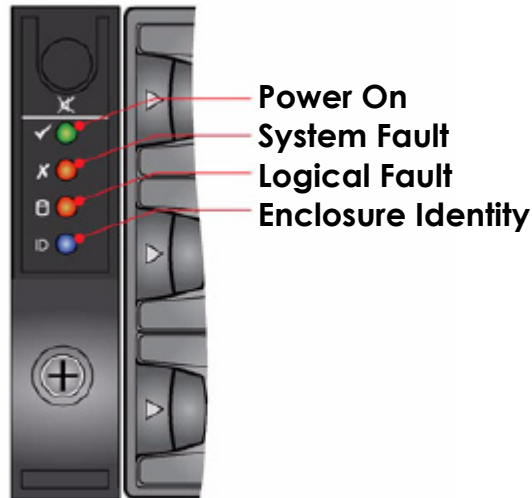
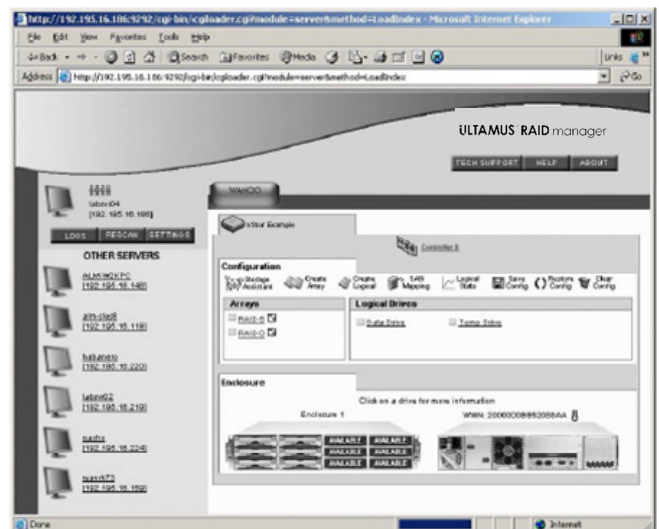


Figure 16. External Status Monitoring

ULTAMUS RAID Manager

ULTAMUS RAID is accompanied by a comprehensive suite of management tools. ULTAMUS RAID provides four types of management tools: the ULTAMUS RAID manager, a web browser-based GUI; SNMP; a command line interface; and support for industry standard management frameworks via SNIA's SMI-S interface. The ULTAMUS RAID manager:

- Is an intuitive, platform-independent, RAID controller-resident web browser-based management tool
- Automatically discovers all network-visible ULTAMUS RAID enclosures
- Provides an intuitive and flexible management interface
- Eases configuration through the Storage Assistant Wizard
- Enables global monitoring from anywhere in the world with a single GUI window
- Supports dynamic configuration & provisioning
- Manages cache, volumes and expansion arrays
- Provides intuitive LUN mapping
- Offers a graphical interface with consolidated toolbar
- Enables performance monitoring and statistics



ULTAMUS RAID Agency and Regulatory

The ULTAMUS RAID platform has been certified to meet the agency and regulatory requirements for shipping the product worldwide:

- Listed by Underwriters Laboratories Inc. in accordance with UL 60950
- CAN/CSA C22.2 60950., System IB-3100, Control board IB-3100-C
- Australia / New Zealand AS/NZS 3548 (Class A)
- European Union EN55022: 1994 (Class A) & 89/336/EEC
- Japan VCCI (Class A)
- Taiwan BSMI CNS13438. USA Title 47 CFR, Part 15 (Class A)
- Support for RoHS and WEEE
- RoHS compliant

Summary

ULTAMUS RAID is the next generation of RAID storage equipped with the features storage managers are asking for today as they think ahead to tomorrow. A SAS infrastructure that enables high performance, SAS and SATA II drive intermix and cost-effective capacity expansion coupled with 4 Gb/sec FC host connectivity and an attractive price tag make ULTAMUS RAID exactly the right product for the most storage and performance-intensive applications. The product couples the industry's most advanced technology with comprehensive data protection, high performance and powerful, intuitive management. Minimizing the risk of technological obsolescence maximizes investment protection for storage buyers.

ULTAMUS RAID provides immediate relief for performance-starved business applications. The product is not just a collection of new technologies but rather it is a well balanced and flexible platform that meets the performance, reliability and cost requirements of businesses. ULTAMUS RAID is a next generation platform that incorporates the latest industry standards and is ready to help storage managers build storage solutions that deliver optimal performance, cost containment and data protection.

ULTAMUS RAID arms storage managers with the tools they need to implement storage strategies and build IT infrastructures that align with both today's and tomorrow's business and data management needs.