

Product Overview:

The VCL-SAN is an industrial-grade Storage Area Network (SAN) solution engineered for organizations requiring high-performance, scalable, and resilient storage infrastructure. It delivers enterprise-class performance, fault tolerance, and intelligent data protection for critical environments such as government, financial and enterprise data centers.

Each node supports up to 24 × 24 TB drives, offering 576 TB raw capacity per node.

Powered by VCL's distributed-storage architecture and managed through the VCL-SAN UI, administrators gain centralized control, real-time analytics, and automated resiliency with Mirrored and Parity-based pools.

The system is supplied with a perpetual licence - all software, management, and security features are included, with no annual or recurring fees.

Cluster Management and Scalability:

- **Dynamic Node Addition / Removal:** Expand or shrink capacity without service interruption.
- **Automatic Rebalancing:** Data automatically redistributes when nodes or disks are added or replaced.
- **High Availability Architecture:** Continuous access even during node or disk failure.
- **Integrated Cluster Health Dashboard:** Live status of Nodes, Disk Store and services.

Storage and Data Management:

- Thin Provisioning for efficient capacity usage
- Data Scrubbing to detect silent corruption
- Storage Pools for logical grouping
- Mirrored and Parity-based Pools
- Quality of Service (QoS) per volume (*per image*).

Monitoring and Reporting:

- **Real-Time Performance Graphs:** throughput, latency, IOPS and capacity visualization
- **Capacity forecasting:** Predictive analytics for expansion planning
- **Integrated Health Reporting:** Displays utilization, error counts, and snapshot schedules.

VCL-SAN UI - Management and Visualization:

- The VCL-SAN UI provides a secure, web-based management interface designed for centralized cluster visibility, capacity monitoring, and operational oversight. The dashboard presents a real-time view of cluster health, storage utilization, and performance metrics, enabling administrators to monitor and manage the SAN environment efficiently.



Cybersecurity and Access Control:

- **Role-Based Access Control (RBAC):** Define user roles with specific privilege levels
- **Storage Quotas:** Set per-volume limits to manage resource utilization and ensure balanced allocation
- **Client-Based Access Restriction:** iSCSI clients are authenticated and authorized using unique initiator ID's for secure volume access. (*iQN Based and CHAP*)
- **Volume-Level Encryption:** Data at rest is protected through the system's integrated storage-encryption mechanism
- **Secure HTTPS Web Interface:** All administrative operations occur over SSL-encrypted HTTPS sessions.

Backup and Recovery:

- **Read-Only Snapshots with long-term retention policies:**
 - Daily - 2 weeks
 - Weekly - 1 year
 - Monthly - 5 years
 - Annually - 10 years
- Automated replication between nodes
- Automated data healing: Self-healing mechanism reconstructs missing or corrupted data blocks
- NTP synchronization: Ensures time-aligned replication and logs across all nodes.

Software Specifications:

Feature	Description
Storage Type	Clustered Storage Area Network
Supported Protocols	iSCSI
Data Protection	Mirrored and Parity-Based Pools
Storage Pools	Logical Grouping for performance and tiering
Network Stack	TCP/IP IPv4 & IPv6 Dual Stack
Access Authentication	Client-based iSCSI ID authentication
Backup and Recovery	Encrypted Replication and Read-Only Snapshots
Snapshot Retention	Daily, Weekly, Monthly and Annual Policies
NTP Synchronization	Clock alignment for backups and snapshots
QoS Control	Assign IOPS or bandwidth limits per volume
CLI Interface	Command-Line management available
Monitoring and Alerts	Real-time health and email notifications
Client OS support	Windows, Linux, Unix-based systems.

Hardware Specifications:

Parameter	Specification
Supported Drive Types	SAS HDD (≥10,000 RPM), SATA HDD (7,200 RPM), SSD
Hot Swappable Drives	Yes
Expandability	Minimum 50% expansion supported through additional enclosures and node scaling
Storage Architecture	Distributed Software-Defined Storage
Data Protection	Mirrored and Parity-Based Pools (Equivalent to RAID 5 / RAID 6 or better)
Controller Architecture	Distributed cluster-based architecture (No single point of failure)
Power Supply	Dual Redundant Power Supply
SAN Interface	iSCSI over Ethernet (10G / 25G / 100G supported)
Fibre Channel Ports	2 × 16 Gbps FC ports (expandable to higher port density and 32 Gbps configurations)

Licensing and Support:

Perpetual licence with no annual or recurring fees. Software updates and technical support available through authorized channels.

Summary:

The VCL-SAN delivers a resilient, scalable, and secure SAN solution built for modern data centers, offering intelligent storage management and long-term operational efficiency under a perpetual licensing model.

Fault Tolerance and Data Protection

The VCL-SAN ensures high availability and data integrity through distributed data protection mechanisms. Data is intelligently distributed across multiple disks and storage nodes, enabling the system to tolerate both individual disk failures and complete node failures without service disruption.

The system supports mirrored and parity-based storage pools, providing fault tolerance equivalent to traditional RAID 5 and RAID 6 configurations. Parity-based protection ensures resilience against multiple simultaneous failures while maintaining continuous data accessibility.

Data protection is further enhanced through automated data healing and rebalancing, ensuring that data redundancy is restored automatically in the event of hardware failures.

Thermal (Heat Load) Characteristics:

Component	Heat Dissipation
Base Chassis (24-bay, without disks)	~450 BTU/hr
SATA HDD (7,200 RPM, 10W)	~34.1 BTU/hr per drive
SAS HDD (10K RPM, 12W)	~40.9 BTU/hr per drive
SSD (5W)	~17.0 BTU/hr per driv

Note: Heat load calculations are based on maximum power consumption using the formula: BTU/hr = Watts × 3.41
Actual values may vary depending on workload and operating conditions.

Key Capabilities:

Centralized SAN Dashboard: A unified dashboard displaying overall cluster status, system health, uptime, and master node information for quick operational assessment.

Cluster Health and Status Monitoring: Real-time indication of cluster state (Healthy / Degraded), including service availability and system operational status.

Storage Capacity Visualization: Graphical representation of total, used, and available storage capacity, enabling instant visibility into storage consumption trends.

Node-Level Visibility: Detailed view of individual SAN nodes, including:

- Hostname
- IP address
- Node health status
- Allocated capacity
- Uptime

Performance and Utilization Metrics: Live performance indicators, including:

- Read and write IOPS
- Client throughput (reads and writes)
- Latencies
- Recovery throughput
- Time-range based performance views (e.g., last 1 hour).

Alert and Event Status Panel: Dedicated alert section providing real-time visibility into system warnings, faults, or confirmation of optimal system operation.

Storage Pool and Block Management Navigation: Intuitive navigation for managing storage pools and block-level resources through the graphical interface.

Secure HTTPS Access: All management and monitoring activities are performed over a secure HTTPS web interface to ensure protected administrative access.

Modern and User-Friendly Interface: Clean, responsive dashboard layout designed for operational clarity and ease of use in enterprise data center environments.

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