HP OpenVMS Systems

The world’s leader in clustering

Providing highly available, unlimited high-end computing for your business needs

Expanding the limits of the world's leading clusters

Hewlett-Packard Company continues to develop systems that are more reliable, faster, and more affordable. And at the same time ensuring that existing systems are compatible within new OpenVMS clusters.

With more than 50,000 clusters installed and supported worldwide, HP’s support for OpenVMS clustering capabilities continues to improve, with additional features being added with every release.

Apply this high performance technology to your business-critical computing needs — the ones that keep your orders flowing, money moving, and customers happy. Then relax knowing that your OpenVMS cluster system has the high availability — or even disaster tolerance capabilities — you need to stay in business.

What is an OpenVMS Cluster?

An OpenVMS Cluster is a highly integrated organization of Alpha and/or VAX computer systems, application and operating system software, and storage devices. The systems can be connected to each other and storage components in a variety of ways, depending on the needs of your business. OpenVMS Cluster systems give you the ultimate in a highly available, scalable, and flexible computing environment. The cluster also allows you to connect systems of all sizes and capacities and achieve an easy-to-manage, single virtual system.

OpenVMS Clusters offer a wide range of potential configurations. Any business — from the smallest office to the largest enterprise — can profit from the benefits of clusters.

The unlimited high-end server for OpenVMS and Windows NT environments

HP joined forces with Microsoft Corporation to deliver the mission critical, bet-your-business capabilities of OpenVMS to Windows applications. Using OpenVMS Clusters as the server system for Windows NT clients provides the bullet-proof, high availability computing advantages for which OpenVMS clusters are legendary.

24x365 computing

If your business demands that your computer system is ALWAYS available, OpenVMS is your only choice. HP supports a wide range of approaches to high availability to meet your specific computing requirements — 24 hours a day, 365 days a year. All of our solutions have been designed and tested to work in today's multivendor client/server environment.

When a single system shuts down in a traditional single-system computing environment or in many other "cluster systems" no other system on the network can access the information on its disks, resulting in costly downtime. With OpenVMS Cluster configurations, you can connect storage subsystems to I/O interconnects that can be accessed by multiple systems. This means that if a node shuts down, all remaining nodes in the OpenVMS Cluster still have access to its applications and data.

Scalable and flexible

With OpenVMS Clusters, you can expand your server configurations from the low-end to the high-end without having to trade in or retire your hardware investments. Start with a single VAX or Alpha system and, when you need to increase computing power, simply add another system to the cluster--without replacing existing systems or applications. They all work together running the powerful, business-critical OpenVMS operating system.

Since HP’s clustering capabilities range from clusters of two systems to 96 systems, they scale to meet your needs. And with numerous connection capabilities, you can be assured that the correct technology will be applied to your business needs--whether your business requires extraordinarily fast I/O, massive storage capabilities, or the need to add new systems to current OpenVMS clusters.

Disaster tolerance

OpenVMS Clusters can be configured into disaster tolerant multisite clusters located up to 500 miles (800 kilometers) apart. With distances of this magnitude, natural or man-made disasters that could potentially put you out of business are no longer threats. Regional disasters such as earthquakes, power outages, floods, and fires are virtually eliminated as interruptions to your business.

Within your OpenVMS cluster, CPUs retain their independence--yet greatly benefit from common resources such as shared processing resources, data storage, tape drives, and batch and print queues. No single point of failure can bring an application down.

As Datamation says, "According to a survey of 400 large companies conducted by Oracle, downtime costs a company $1400 per minute, on average. Based on these figures, 43 hours of downtime per year would cost $3.6 million. One hour of downtime per year amounts to $84,000 per year." (Datamation August 15, 1995)

Technical Features

OpenVMS Clusters provide the full spectrum of cluster features that you would expect in a leadership product. For example:

- High Performance Distributed Lock Manager
    - The Distributed Lock Manager is at the heart of an OpenVMS Cluster. It is used pervasively by the operating system, and is available for application use. All file operations, whether RMS or database based, are coordinated by the lock manager. The lock manager provides all the features expected in a leadership implementation, including asynchronous completion, asynchronous blocking notification, deadlock detection, lock trees, lock quotas, dynamic remastering, value blocks, etc.
- Fully Cluster-wide File System
    - All disks are equally accessible by any node in the cluster. All nodes can issue file operations to the same disk at the same time. There is no requirement for a "file serving" mode of operation. The distributed lock manager coordinates file operations automatically.
- Cluster-wide Batch and Print subsystem
    - Any node in the cluster can submit batch and print jobs to any queue in the cluster. OpenVMS provides the concept of "generic" queues and "execution" queues. Jobs can be submitted to generic queues that then feed the job to any of several execution queues. For example, if you have a job that must run every day at midnight, you can submit it to a generic queue. Then, every evening at midnight, the batch subsystem will identify an available execution queue on any available node on which to run the job. There's no tying of jobs to nodes!
- A Connection Manager
    - The OpenVMS Cluster Connection Manager is responsible for controlling cluster node membership. Using a Votes and Quorum mechanism, the Connection Manager ensures that cluster nodes are admitted to the cluster correctly and that resources are reallocated across the cluster when nodes shut down. The "transition" time for nodes when joining and leaving the cluster is the fastest in the industry - generally fewer than 10 seconds.

- Shared System Disk
    - Because OpenVMS Clusters have a fully shared file system, it is possible for several nodes to share, and boot off, a single system disk. This greatly simplifies system management, because tasks such as software layered product installations, system upgrades, and system disk backups only have to be done once.
- Single Security Domain
    - OpenVMS Clusters implement exactly the same security mechansims as single OpenVMS systems. All access controls, alerts, auditing, logging, and security management functions operate cluster-wide.
- Disk and Tape Servers
    - The OpenVMS MSCP and TMSCP disk and tape servers allow any node in a cluster to directly access any disk or tape - without the need to be directly connected to the device. This features greatly enhances the "a cluster should look and feel like a single system" attribute of OpenVMS Clusters. Remote client nodes, possibly miles away, can access devices located on central server systems in exactly the same manner as locally connected devices.
- Single System Management Domain
    - OpenVMS Clusters are managed virtually the same as a single system. For example, a management command can be directed to execute on every node in the cluster. A Motif-based, multi-node display utility (DECamds) can be used to monitor and control resource utilization across the cluster as a single entity. All system databases - such as the account and password database, the batch/print database, and the network database - are shared by every node in the cluster, so need to be manipulated only once for changes to be realized across the cluster.
- Cluster-wide Process Control API
    - OpenVMS Clusters provide a comprehensive API for cluster-wide operations. A process can create, monitor, control and delete another process on any node in the cluster. Processes can elect to be notified of cluster membership changes. System utilities take advantage of these abilities and can display information for the entire cluster, rather than for just the node on which the utility is executed.
- Mixed Architecture Clusters
    - Any member of the HP VAX or Alpha family of computers can be configured into an OpenVMS Cluster.

- Rolling Upgrade Support
    - OpenVMS Clusters that are configured with more than one system disk can run different versions of OpenVMS on each disk. This allows nodes in an OpenVMS Cluster to be upgraded in a "rolling" fashion. This process, called migration, allows upgrades to be done over a period of time as applications are upgraded to take advantage of the new operating sytem and layered product features.
- Parallel I/O
    - All OpenVMS Cluster nodes can issue I/O requests to storage devices at the same time. Routing I/O activity to a device through a single node is not necessary. The distributed lock manager automatically coordinates access to shared devices. This feature greatly increases the I/O throughput of an OpenVMS Cluster.
- Interconnect Failover
    - All OpenVMS Cluster interconnects operate together. OpenVMS Cluster software chooses the fastest available interconnect for I/O and node-to-node transfers. If an interconnect becomes unavailable, the cluster software will automatically fail over to the next fastest interconnect.
- High End Scaling
    - OpenVMS Clusters can scale to meet any computing and storage need. Up to 96 nodes may be configured into a cluster, using any mix of systems from workstations to enterprise servers. Storage subsystems can scale on multiple interconnects to many terabytes of on-line data. Multiple network interconnects can be configured to provide high performance external connectivity. The OpenVMS Cluster Batch and Print subsystem supports many hundreds of queues.
- Load Balancing
    - OpenVMS Cluster software performs load balancing at many levels. The I/O subsystem, the distributed lock manager, the batch/print subsystem, user logins, network links, etc are all load balanced.
- Cluster Alias
    - With appropriate network products, OpenVMS Clusters provide a network "alias" feature that allows incoming network links, either DECnet or TCP/IP, to be targeted at the cluster by a single name. The load balancing software chooses which actual cluster node will service the network link. Outgoing network traffic also uses this feature, so that, for instance, e-mail leaving the cluster uses the cluster alias name rather than the name of a specific node.

- Full RAID support
    - OpenVMS Cluster storage subsystems can take advantage of a complete suite of RAID products. Host-based and controller-based implementations of RAID-0 (striping), RAID-1 (shadowing or mirroring), RAID-3/5 are available as separately orderable products.

OpenVMS Clusters provide the best clustering features in the industry!

- **Highest availability**: Guarantees access to your data and applications
- **Easy expansion**: Lets you expand your cluster to the size you want, when you want, how you want - without requiring you to shut down your cluster and interrupt your business!
- **Accessibility** to all resources: Lets all your users access the resources in an OpenVMS Cluster
- **Easy-to-manage**: Lets you manage your entire OpenVMS Cluster of multiple systems as a single system
- **Seamless integration** with existing systems and new technologies: Allows you to integrate your current equipment into the same OpenVMS Cluster along with new VAX and Alpha systems
- **A choice of packaging minimizes floorspace:** When space is at a premium, OpenVMS Clusters can be constructed using rackmountable AlphaServers(TM) and StorageWorks(TM) components to fit your computer room constraints.

OpenVMS Clustering Interconnect Choices

Select one that meets your needs, or mix interconnects when your needs change!

Systems and storage in an OpenVMS Cluster exchange information by means of physical communication links known as interconnects. OpenVMS Clusters offer a range of interconnect choices including:

- Small Computer Storage Interconnect (SCSI)
- Memory Channel (MC)
- Computer Interconnect (CI)
- Local Area Network infrastructures: Ethernet and FDDI (Fiber Distributed Data Interface)
- Digital Storage Systems Interconnect (DSSI)

SCSI--the Small Computer Storage Interconnect Standard

The ideal starting point for configuring a low-end, affordable cluster solution

With SCSI-based clusters, you can use commodity-priced storage devices directly in OpenVMS Clusters of Alpha systems. SCSI is an industry-based standard bus based on the work of the American National Standards Institute (ANSI). It defines the ways in which peripheral devices can access a standard, general-purpose bus and has become the key design standard for increasingly small, fast, reliable, and low-cost storage devices.

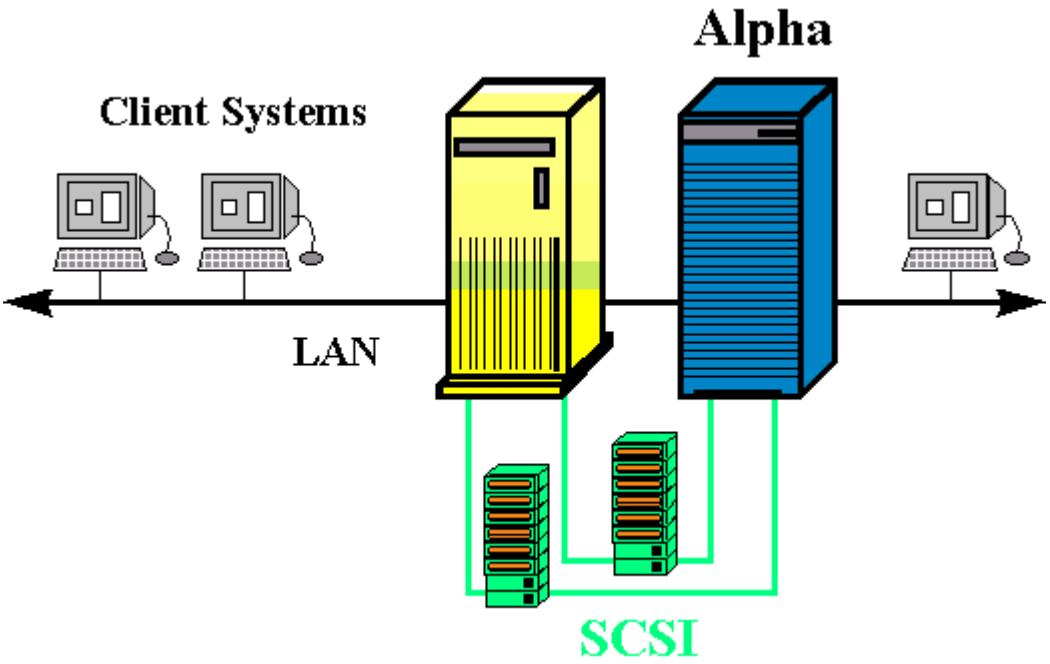
SCSI clusters can range from desktop and deskside to the largest configurations. They can be configured with no single point of failure.

HP contributed extensively to the development of this standard and takes fullest advantage of the current protocol (SCSI-2) in SCSI-based OpenVMS Clusters to deliver high performance and availability.

Choices in distance, cost, and performance

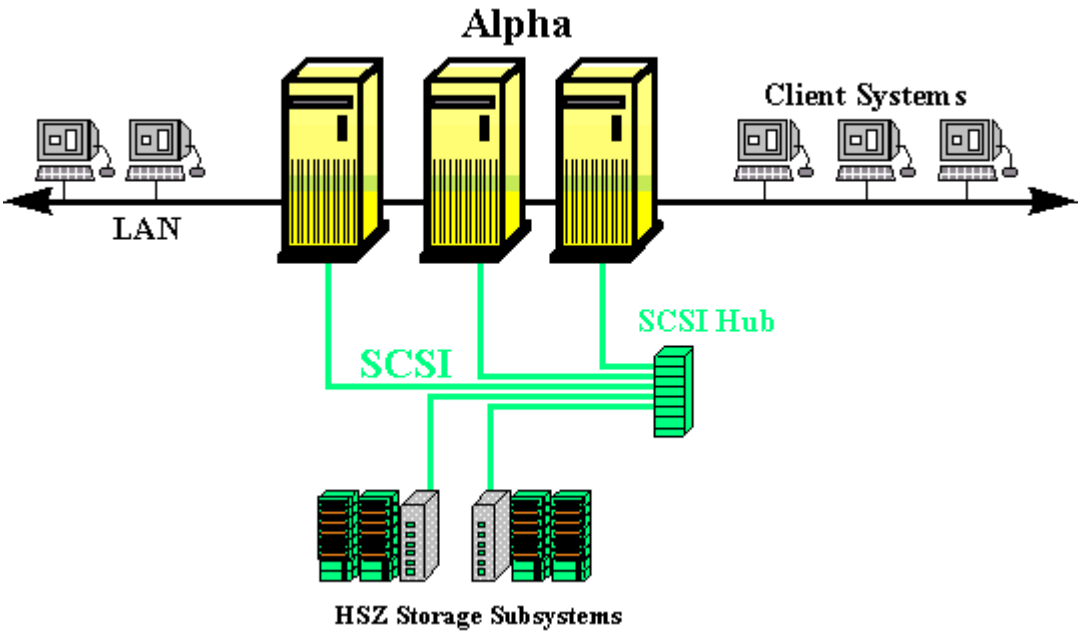
The SCSI interconnect in an OpenVMS Cluster provides a balance of distance, price, performance, and storage capacity. Transfer rates now range from 10 to 20 megabytes/second as the SCSI bus has been improved over the years. The maximum length of the SCSI interconnect is 25 meters using differential devices.

Example: SCSI-based OpenVMS Cluster using two SCSI buses with directly attached disks



The configuration above comprises a small, two-node cluster with directly attached disks. This configuration does not require a separate storage controller, thereby reducing the cost. Like all other OpenVMS Clusters, it can be configured with a single system disk from which both nodes can boot. For higher availability the system disk could be shadowed (using the OpenVMS Volume Shadowing host-based RAID-1 product) to a disk on the second SCSI bus. A tie-breaking Quorum Disk can also be located on one of the SCSI buses. The configuration could be expanded by the addition of a third Alpha system, and another four shared SCSI buses (up to six in total).

Example: SCSI-based OpenVMS Cluster using FWD HSZ Controllers



The SCSI Hub in the example above comprises a BA356 StorageWorks rack filled with up to 5 DWZZB level converters. A single FWD SCSI cable is run from each DWZZB to a system or storage controller. This style of "star" configuration provides up to 20 meters of radial connectivity and easier maintenance because each SCSI cable is individually terminated.

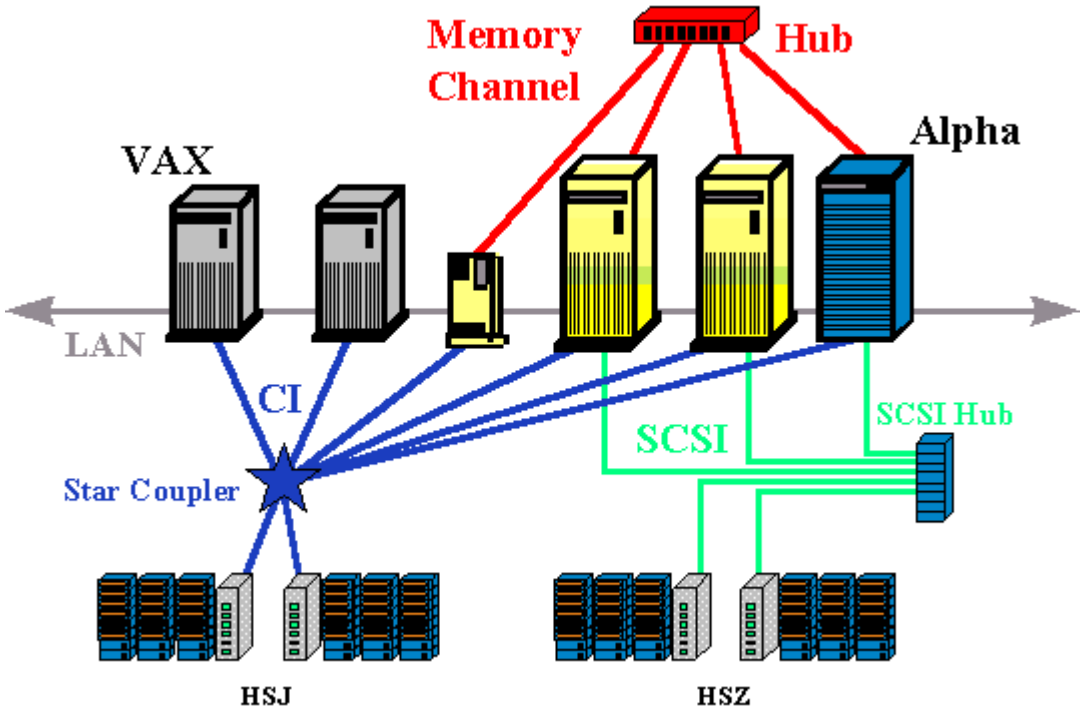
OpenVMS Memory Channel (MC)

Memory Channel (available with OpenVMS V7.1) is a new high performance interconnect for PCI-based Alpha systems in OpenVMS clusters. Memory Channel supports all cluster features - as do all existing cluster interconnects - without any changes required to your existing software.

Memory Channel delivers high performance node-to-node communication, while a separate interconnect, such as CI, SCSI, or DSSI is used to provide access to storage.

HP developed Memory Channel to provide high-performance OpenVMS lock manager capabilities for today's VLDB (Very Large Database) implementations, such as Oracle.

Example: OpenVMS Cluster based on Memory Channel and SCSI

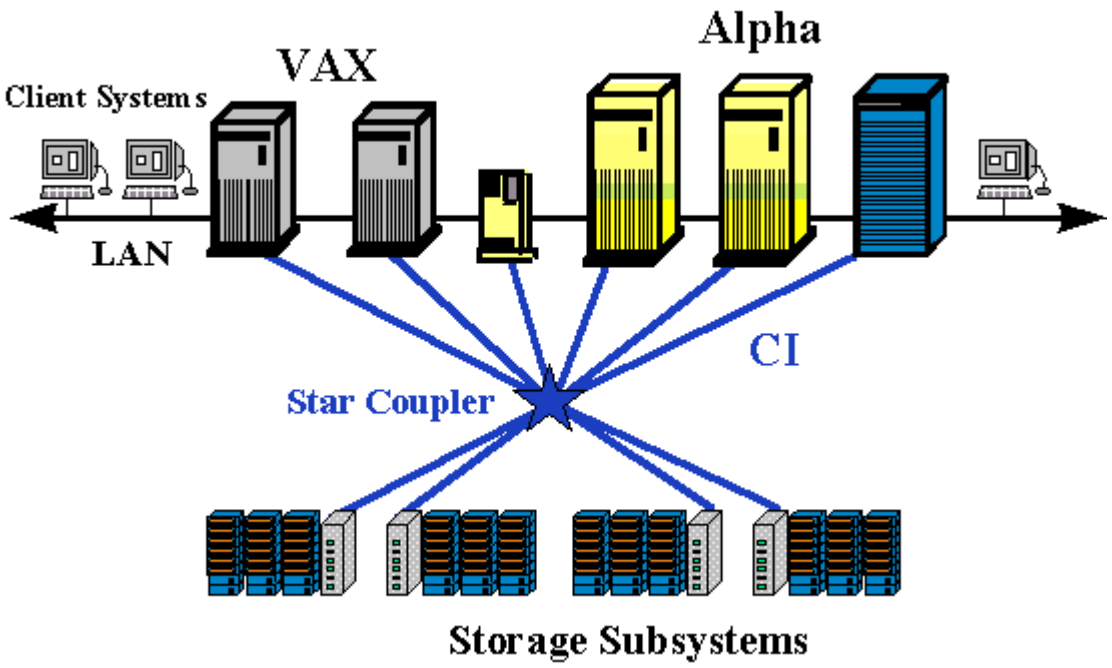


Computer Interconnect (CI)

Gain fast, efficient access to large amounts of data

When connecting datacenter VAX systems, Alpha systems, and independent storage devices to form a cluster, CI allows for extremely high-speed, dual-path communications for large systems and I/O-intensive applications. It permits efficient access to huge amounts of data while providing redundant data paths (140 megabits per second). CI clusters offer the highest levels of availability and throughput since systems and storage devices are dual pathed. A CI component, the Star Coupler, allows center connection of up to 32 nodes (systems or storage devices) in a "star-shaped" OpenVMS Cluster.

Example: CI-based OpenVMS Cluster comprised of Alpha and VAX systems



Local Area Network (LAN) interconnects: Ethernet and FDDI

Ethernet: an affordable, flexible, network medium

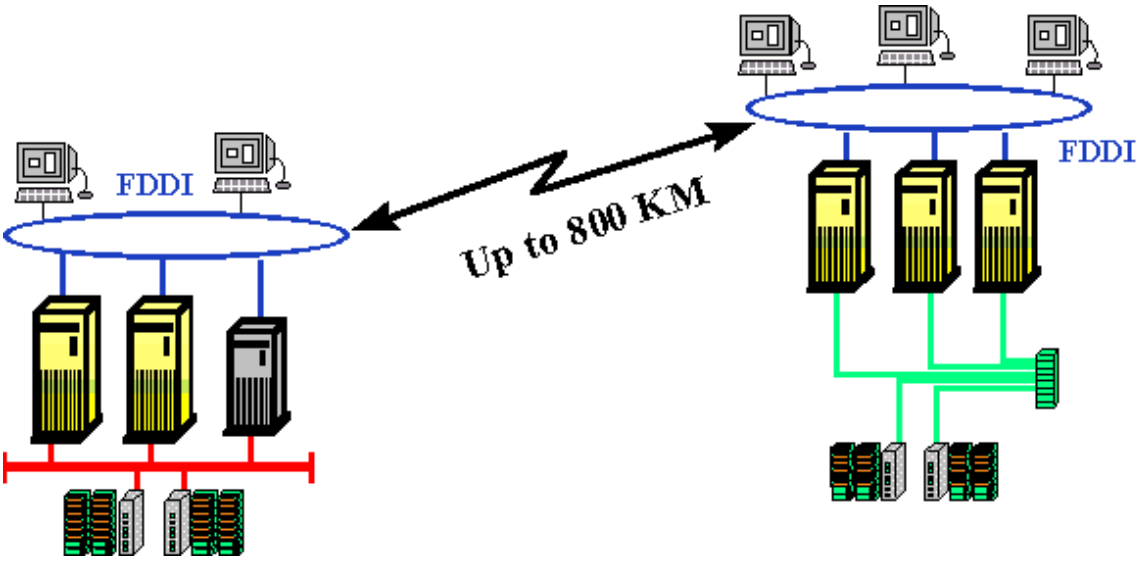
The Ethernet, an industry-standard network interconnect of single path connections, provides the backbone for low-cost OpenVMS Clusters or local area networks. Ethernet-based OpenVMS Clusters can connect up to 96 systems. In addition to normal 10Mb/sec Ethernet, high speed 100Mb/sec Fast Ethernet configurations are also supported by OpenVMS Cluster software.

FDDI: links multiple sites into a single operating environment

An ANSI and IEEE standard for high-speed, multivendor networking interconnections, FDDI extends cluster availability to multiple physical sites (up to 25 miles/40 kilometers apart) to form a single operating environment consisting of up to 96 systems. FDDI uses high-speed fiberoptic cable as a transmission medium. Computing resources that are currently physically located outside your data center can now be tied into it using FDDI.

FDDI can be used to create disaster-tolerant OpenVMS Clusters. Linking sites using DS3, asynchronous transfer mode (ATM), and microwave technology is possible using FDDI in conjunction with HP's Gigaswitch bridging product.

Example: Disaster Tolerant OpenVMS Cluster comprising two sites with SCSI and DSSI based configurations

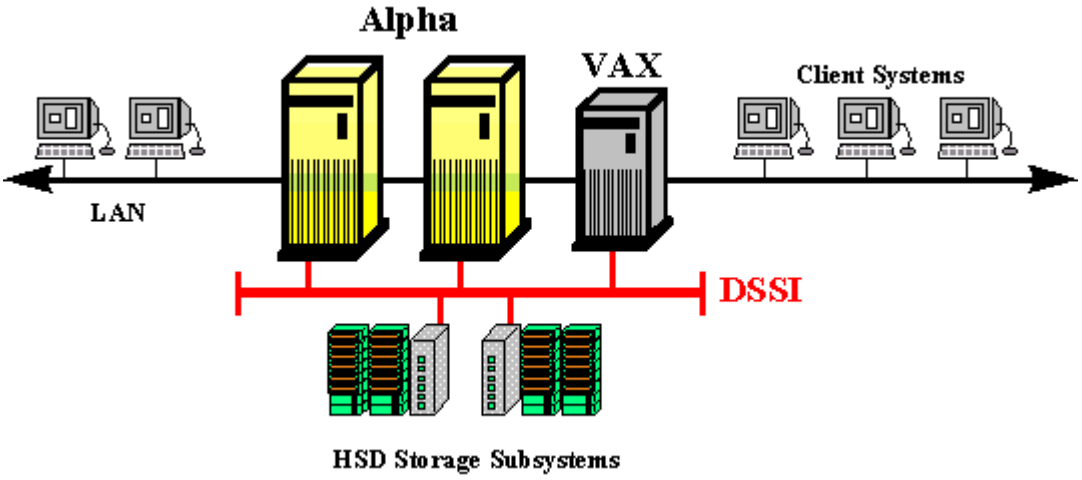


Digital Storage Systems Interconnect (DSSI)

Providing a low-cost connection for clusters containing Alpha and VAX systems

Used in office and datacenter environments, DSSI links VAX systems, Alpha systems, and intelligent storage devices into multihost configurations through a low-cost DSSI bus. DSSI permits systems to communicate directly with each other, and can connect up to four nodes in an OpenVMS Cluster. Most DSSI clusters utilize multiple buses.

Example: DSSI-based OpenVMS Cluster



Mixed Interconnect

Combine interconnects the way you want . . . the way you need

One of the advantages of an OpenVMS Cluster is that it allows you to mix interconnects to meet your needs. The best choice depends upon your performance requirements. Four of the most critical factors to consider include:

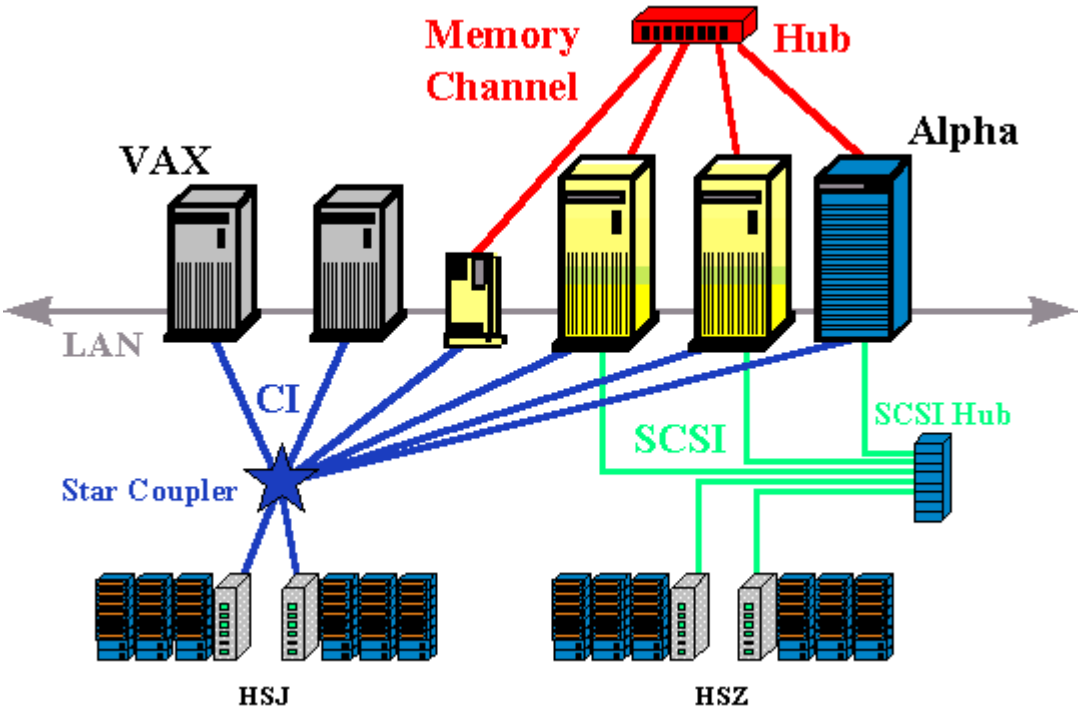
1. **Throughput** - What are the data requirements to be placed on the interconnect? Between specific systems in a cluster? Between specific systems and specific storage devices in the cluster?

2. **Availability** - Does your computing environment require that no communication path be a single point of failure for communication among specific systems and specific storage disks?

3. **System Distribution** - Do all systems reside in a single computer room? Or are they spread throughout a building, a small complex of buildings, or distributed over a very large geography?

4. **Scalability** - How much computing power and storage capacity growth are you likely to need as your business and application requirements increase?

Example: OpenVMS Cluster using multiple interconnects - CI, Memory Channel and SCSI



HP OpenVMS Cluster Interconnects At-a-Glance

SCSI	Memory Channel	CI	DSSI	LAN
3 systems	4 systems	16 systems	4 systems	96 systems
Max 20 MB/sec	Max 100 MB/sec	Max 17.5 MB/sec	Max 4 MB/sec	Max 12.5 MB/sec - FDDI Max 1.25 MB/sec - Ethernet
25 Meters	6 Meters	90 Meters	25 Meters	40 KM - FDDI 2 KM - Ethernet
Alpha Only	Alpha only	VAX & Alpha	VAX & Alpha	VAX & Alpha
0.3TB per bus	Node-to-node traffic only	2.6 TB per bus	0.6 TB per bus	No directly attached storage
Up to 6 buses per system	Up to 2 buses per system	Up to 18 buses per system	Up to 24 buses per system	Unlimited number of buses

When it comes to benefits, nothing comes close to OpenVMS Clusters

HP OpenVMS Clusters give you the confidence that your business will stay up and running at all times. Your business will be secure with high-performance systems that deliver constant, disaster-proof access to your applications and data. And as your requirements change and expand, OpenVMS Cluster technology will accommodate your growth and shifting needs without disrupting day-to-day business functions.

Ordering Information

OpenVMS Cluster Software is orderable as follows:

Every server (non-client) Alpha system in a OpenVMS Cluster configuration requires:

- OpenVMS Cluster Software for OpenVMS Alpha
    - Software Licenses: QL-MUZA*-AA

Every server (non-client) VAX system in a OpenVMS Cluster configuration requires:

- VAXcluster Software for OpenVMS VAX
    - Software Licenses: QL-VBRA*-AA

"*" denotes variant fields. For additional information on available licenses, services, and media, refer to the appropriate price book.

Refer to your local price book for pricing information.