COMPAQ

Software Product Description

PRODUCT NAME: Compaq Galaxy Software Architecture on OpenVMS Alpha, Version 1.0
SPD 70.44.00

Note:

This SPD describes the Compaq Galaxy Software Architecture on OpenVMS, which is available as a separately licensed System Integrated Product (SIP).

Throughout this document, **OpenVMS Galaxy** and **Galaxy** refer to the **Compaq Galaxy Software Architecture on OpenVMS**. The term **instance** refers to a copy of the OpenVMS Alpha operating system.

DESCRIPTION

The Galaxy Software Architecture on OpenVMS Alpha (OpenVMS Galaxy) is Compaq's first implementation of the APMP model of computing. OpenVMS Galaxy enables multiple instances of OpenVMS to execute cooperatively in a single computer, giving customers the ability to manage unpredictable, variable, or growing workloads. With OpenVMS Alpha Version 7.2, customers can configure AlphaServer 8400, 8200, and 4100 systems as OpenVMS Galaxy systems.

Adaptive Partitioned Multiprocessing (APMP) is a new model of computing in which multiple instances of operating systems execute cooperatively in a single computer. With APMP, many processors, and other physical resources, are partitioned in order to run multiple instances of operating systems. Each instance has assigned CPUs, memory, and I/O. The instances share a part of the memory, and CPUs can be reassigned from one instance to another while the system is running. This computing environment can be dynamically adapted to meet changing application needs and workload demands.

Software logically **partitions** systems by assigning CPUs, memory, and I/O ports to individual instances of the OpenVMS operating system. This partitioning, which a system manager directs, is a software function; no hardware boundaries are required. Each individual instance has the resources it needs to execute independently. An OpenVMS Galaxy environment is **adaptive** in that resources such as CPUs can be dynamically reassigned to different instances of OpenVMS.

Memory is logically partitioned into private and shared sections. Each operating system instance has its own private memory, which means that no other instance writes to those physical pages. Some of the shared memory is available for instances of OpenVMS to communicate with one another, and the rest of the shared memory is available for application data.

An OpenVMS Galaxy has a highly scalable I/O subsystem because there are multiple, primary CPUs in the system—one in each instance. In addition, OpenVMS currently has features for distributing some I/O to secondary CPUs in an SMP system.

CPUs within an OpenVMS Galaxy are allocated to instances.

On an OpenVMS Galaxy, the **console firmware** plays a critical role in partitioning hardware resources. It maintains the permanent configuration in NVRAM and the running configuration in memory. The console provides each instance of the OpenVMS operating system with a pointer to the running configuration data.

The console performs power-up self tests, initializes hardware, initiates system booting, and performs I/O services during system booting and shutdown. The console program also provides run-time services to the operating system for console terminal I/O, environment variable retrieval, NVRAM saving, and other services.

An OpenVMS Galaxy computing environment lets customers decide how much cooperation exists between instances in a single computer system.

In a **shared-nothing** computing model, the instances do not share any resources; operations are isolated from one another.

In a **shared-partial** computing model, the instances share some resources and cooperate in a limited way.

In a **shared-everything** model, the instances cooperate fully and share all available resources, to the point where the operating system presents a single cohesive entity to the network.

OpenVMS Galaxy leverages proven OpenVMS Cluster, symmetric multiprocessing (SMP), and performance capabilities to offer greater levels of performance, scalability, availability and flexibility.

By running multiple instances of OpenVMS in a single computer, an OpenVMS Galaxy computing environment gives you quantum improvements in:

- Compatibility—Existing applications run without changes.
- Availability—Presents opportunities to upgrade software and expand system capacity without downtime.
- Scalability—Offers scaling alternatives that improve performance of SMP and cluster environments.
- Adaptability—Physical resources can be dynamically reassigned to meet changing workload demands.
- Cost of ownership—Fewer computer systems reduce system management requirements, floor space, and more.

For companies looking to improve their ability to manage unpredictable, variable, or growing IT workloads, OpenVMS Galaxy technology provides a flexible way to dynamically reconfigure and manage system resources.

An OpenVMS Galaxy computing environment is ideal for high-availability applications, such as:

- Database servers
- Transaction processing systems
- Data warehousing
- Data mining
- Internet servers

Software and Hardware Components

An OpenVMS Galaxy computing environment is comprised of the following:

- OpenVMS Alpha operating system
- AlphaServer Console Firmware
- Supported hardware

For more information about these components, see the software requirements or hardware requirements sections in this SPD.

OPENVMS ALPHA VERSION 1.0 GALAXY FEATURES

With OpenVMS Alpha Version 7.2, you can create an OpenVMS Galaxy computing environment that allows you to:

- Run three instances of OpenVMS on an AlphaServer 8400
- Run two instances of OpenVMS on an AlphaServer 8200
- Run two instances of OpenVMS on an AlphaServer 4100
- Reassign CPUs between instances
- Perform independent booting and shutdown of instances
- Use shared memory for inter-instance communication
- Cluster instances within an OpenVMS Galaxy using the Shared Memory Cluster Interconnect (SMCI)
- Cluster instances with non-Galaxy systems
- Create applications using OpenVMS Galaxy APIs for resource management, event notification, locking for synchronization, and shared memory for global sections
- Use the Galaxy Configuration Utility (GCU) to view and control the OpenVMS Galaxy environment
- Run a single-instance OpenVMS Galaxy on any Alpha system for application development

The following sections describe some of features in more detail.

Galaxy Configuration Utility

The Galaxy Configuration Utility is a DECwindows Motif application that allows system managers to configure and manage an OpenVMS Galaxy system from a single workstation window.

Using the GCU, system managers can:

- Display the active Galaxy configuration.
- Reassign resources among Galaxy instances.
- View resource-specific characteristics.
- Shut down or reboot one or more Galaxy instances.
- Invoke additional management tools.

- Create and engage Galaxy configuration models.
- Create a single-instance Galaxy on any Alpha system (for software development on non-Galaxy hardware platforms).
- View the online Galaxy documentation.
- Determine hot-swap characteristics of the current hardware platform.

Shared Memory Cluster Interconnect

The Shared Memory Cluster Interconnect (SMCI) is a System Communications Services (SCS) port for communications between Galaxy instances. When an OpenVMS instance is booted as both a Galaxy and as an OpenVMS Cluster member, the SMCI driver is loaded. This SCS port driver communicates with other cluster instances in the same Galaxy through shared memory. This capability provides one of the major performance benefits of the OpenVMS Galaxy Software Architecture. The ability to communicate to another clustered instance through shared memory provides dramatic performance benefits over traditional cluster interconnects.

Local Area Network (LAN) Shared Memory Device Driver

Local Area Network (LAN) communications between OpenVMS Galaxy instances are supported by the Ethernet LAN shared memory driver. This LAN driver communicates to other instances in the same OpenVMS Galaxy system through shared memory. Communicating with other instances through shared memory provides performance benefits over traditional LANs.

Application Programming Interfaces

- Locks for synchronization
- Event notification
- Shared memory global sections
- Configuration information
- CPU management

For more information about OpenVMS Galaxy APIs, refer to the *OpenVMS Alpha Galaxy Guide*.

Single-Instance Galaxy Configuration

A single-instance Galaxy is for non-Galaxy platforms, that is, those without a Galaxy console. Galaxy configuration data, which is normally provided by console firmware, is instead, created in a file. By setting the system parameter GALAXY to 1, SYSBOOT reads the file into memory and the system boots as a single-instance Galaxy, complete with shared memory, Galaxy system services, and even self-reassignment of CPUs. This can be done on any Alpha platform.

Single-instance Galaxy configurations will run on any Alpha workstations or servers running OpenVMS Version 7.2—even laptops. This capability allows early adopters to evaluate OpenVMS Galaxy features, and most importantly, to develop and test Galaxy-aware applications without incurring the expense of setting up a full-scale Galaxy platform.

Because a single-instance Galaxy is not an emulator—it is real Galaxy code—applications developed on a single-instance Galaxy will run on multi-instance configurations.

SOFTWARE REQUIREMENTS

OpenVMS Galaxy configurations require OpenVMS Alpha Version 7.2.

The OpenVMS Alpha Version 7.2 kit includes the following minimum supported version of OpenVMS Galaxy console firmware:

- AS8_G53_27 for AlphaServer 8400 and 8200 systems
- AS4_53_75 for AlphaServer 4100 systems

HARDWARE REQUIREMENTS

Configuring an OpenVMS Galaxy computing environment requires:

- One I/O module (for example, I/O module of type KFTIA or KFTHA on an AlphaServer 8400) for each partition
- At least one processor module for each partition
- A dedicated serial console port for each partition
- Sufficient memory for operating system and required applications

Optional Hardware

OpenVMS Version 7.2 customers might want to use the following optional hardware:

- Plug-in units (PIUs) for I/O expansion from an I/O module (PCI or XMI)
- I/O adapters for network, storage, or traditional cluster interconnects
- Additional CPUs for SMP instances
- Additional memory for Galaxywide global sections

GCU Hardware Requirements

Compaq recommends an Alpha or VAX workstation running DECwindows or a Windows NT workstation with an Xterminal emulator as a display device for the OpenVMS Galaxy Configuration Utility.

SUPPORTED HARDWARE

AlphaServer 8400 Galaxy Configuration

Two or three instances supported on an AlphaServer 8400.

9 slots for:

I/O modules
Memory modules
Processor modules (2 CPUs per module)

Console line for each partition:

Standard UART for first partition
KFE72-DA for each additional partition

Example Configuration 1
2 partitions, 8 CPUs, 12 GB memory

9 slots allocated as follows:

Two I/O modules
Four Processor modules (2 CPUs each)
Three Memory modules (4 GB each)

Example Configuration 2
3 partitions, 8 CPUs, 8 GB memory

9 slots allocated as follows:

Three I/O modules
Four Processor modules (2 CPUs each)
Two Memory modules (4 GB each)

AlphaServer 8200 Galaxy Configuration

One possible OpenVMS Galaxy configuration (two instances only) on an AlphaServer 8200:

5 slots for:

Two processor modules (two CPUs each)
Two I/O modules
One memory module

The AlphaServer 8400/8200 provides a built-in UART for the first console line. Each additional console requires a module set.

The only hardware required for Galaxy operation that is not in the typical AlphaServer 8400/8200 configuration is the KFE72-DA console subsystem.

The KFE72-DA module set is the set of EISA bus modules that establish a console port.

AlphaServer 4100 Configuration

To create an OpenVMS Galaxy on an AlphaServer 4100, you must also be familiar with the following configuration and hardware requirements:

Two-instance maximum

You can run a maximum of two instances of OpenVMS on an AlphaServer 4100.

Console firmware

You must have AlphaServer 4100 console firmware Version AS4_G53_75 (available on the OpenVMS Alpha Version 7.2 kit).

AlphaServer 4100 clock

An AlphaServer 4100 has one clock. For an OpenVMS Galaxy, this means that you cannot run the two instances at different times. Also, the SET TIME command affects both instances. Note that this may not become evident until a number of hours have passed.

Console ports

COM1 (upper) is the console port for instance 0.
COM2 (lower) is the console port for instance 1.

Unlike creating an OpenVMS Galaxy on an AlphaServer 8400, you do not need additional hardware for the second console. COM-2 is used for this purpose.

CPUs

CPU0 must be the primary for instance 0.
CPU1 must be the primary for instance 1.
CPUs 2 and 3 are optional secondary CPUs that can be migrated.

I/O adapters

The four lower PCI slots belong to IOD0, which is the I/O adapter for instance 0.
The four upper PCI slots belong to IOD1, which is the I/O adapter for instance 1.

Storage controllers

You will need two storage controllers, such as KZPSAs. These can go to separate StorageWorks boxes or to the same box for running as a SCSI cluster. One controller each goes in IOD0 and IOD1.

Network cards

If each instance needs network access, a network card (such as a DE500) is required for each instance.

One card each goes in IOD0 and IOD1.

Physical memory

Because OpenVMS Galaxy on an AlphaServer 4100 does not support memory holes, physical memory for an OpenVMS Galaxy environment must be contiguous. To achieve this on an AlphaServer 4100, one of the following must be true:

- All memory modules must be the same size (for example, 1 GB).

- If two sizes are present, only one module can be a smaller size. You must put the larger modules into the lower numbered slots.

LICENSING REQUIREMENTS

The OpenVMS Galaxy Software Architecture on OpenVMS (OpenVMS Galaxy) is a system integrated product (SIP). That is, OpenVMS Galaxy code is integrated and delivered with the OpenVMS operating system.

The License Management Facility (LMF) Product Authorization Keys (PAKs) representing OpenVMS Galaxy licenses allow you to access and use OpenVMS Galaxy software. For more information about the location of the PAKs available with OpenVMS Alpha Version 7.2, see the *Guide to OpenVMS Version 7.2 CD–ROMs*.

The following list summarizes OpenVMS Galaxy licensing requirements:

- One OpenVMS Operating System License for a Galaxy system
- One SMP Extension License for each CPU after the first CPU
- One OpenVMS Galaxy License for each CPU in a Galaxy system
- No changes to how Compaq layered products are licensed:

  One capacity license per system

  One user license per use

The following sections describe these requirements in more detail.

OpenVMS Operating System License

When an AlphaServer system is configured as an OpenVMS Galaxy system, there are no changes in how a system is licensed for the OpenVMS operating system.

One OpenVMS Base License is required for the Galaxy system, plus one SMP Extension License for each CPU after the first CPU.

OpenVMS Galaxy License

In order to create and run multiple instances, one OpenVMS Galaxy License is required for each CPU in a Galaxy system.

License rights for running a single-instance Galaxy on any Alpha system are provided by the OpenVMS Base License.

OpenVMS Layered Products License

Compaq software layered products on OpenVMS Galaxy configurations continue to use standard license types: Traditional, Concurrent Use, and Personal Use.

- One Traditional capacity License will continue to license the system, regardless of the number of instances. The license is based on the system class of the hardware system.
- Concurrent Use Licenses will continue to license one concurrent use of the product.
- Personal Use Licenses will continue to license one named user on the system.

Clustering OpenVMS Galaxy Instances

Instances in an OpenVMS Galaxy computing environment can be clustered with other instances in a single system, with instances in other Galaxy systems, or with non-Galaxy systems. Each type of clustering has different licensing requirements, as described in the following sections.

Clustering in a Galaxy System

In an OpenVMS Galaxy computing environment, instances can be clustered with other instances within a Galaxy system. Clustered instances use the shared-memory cluster interconnect to communicate with each other.

The licensing and functionality for clustering within a Galaxy system is provided under the OpenVMS Galaxy License.

Clustering Outside a Galaxy System

Instances in an OpenVMS Galaxy computing environment can be clustered with instances in another OpenVMS Galaxy system or with cluster nodes in non-Galaxy systems. Instances clustered outside of a Galaxy system use traditional cluster interconnects.

Each system that is clustered with another system must be licensed for OpenVMS Cluster Software. Clustering outside the OpenVMS Galaxy system is not covered by the OpenVMS Galaxy License.

YEAR 2000 READINESS

This product is capable of accurately processing, providing, and/or receiving date data from, into, and between the twentieth and twenty-first centuries and the years 1999 and 2000, including leap-year calculations, when used in accordance with the associated product documentation and provided that all hardware, firmware and software used in combination with the product properly exchange accurate data with the product.

DISTRIBUTION MEDIA

The Compaq Galaxy Software Architecture on OpenVMS Alpha is distributed on the same distribution media as the OpenVMS operating system. Refer to the OpenVMS operating system for VAX and Alpha SPD for more information.

ORDERING INFORMATION

Software Licenses

QL–66XAA–3B	Compaq Galaxy 1 CPU License
QL–66XAA–3C	Compaq Galaxy 2 CPU License
QL–66XAA–3D	Compaq Galaxy 4 CPU License
QL–66XAA–3E	Compaq Galaxy 8 CPU License

Documentation

QL–66XAA–G8	Compaq Galaxy demo CD–ROM and documentation set

The *OpenVMS Alpha Galaxy Guide* describes how to create, manage, and use an OpenVMS Galaxy computing environment. This book includes:

- OpenVMS Galaxy hardware and configuration requirements
- Procedures for creating OpenVMS Galaxy computing environments on OpenVMS Alpha Server 8400, 8200, and 4100 systems
- Complete details about how to use all of the OpenVMS Galaxy features and capabilities available in OpenVMS Alpha Version 7.2

The *OpenVMS Alpha Galaxy Guide* is available on the OpenVMS Version 7.2 documentation CD–ROM in both HTML and PostScript® formats. The latest version is always available at:

http://www.openvms.digital.com

The OpenVMS Galaxy Configuration Calculator (Galculator) is an application program you can use to determine the Galaxy configuration that best suits your needs. The Galculator also contains hardware illustrations. The latest version is available at:

http://www.openvms.digital.com

SOFTWARE LICENSING

This software is furnished under the licensing provisions of Compaq Computer Corporation's Standard Terms and Conditions and the following terms. In case of conflict the latter shall govern. For more information about Compaq's licensing terms and policies, contact your local Compaq office.

License units for OpenVMS Galaxy are allocated on a CPU-capacity basis. An OpenVMS Galaxy license is required for each CPU within a system.

License Management Facility Support

This system integrated product supports the OpenVMS License Management Facility.

For more information on the License Management Facility, refer to the OpenVMS Operating System for VAX and Alpha Software Product Description (SPD 25.01.xx), or the appropriate operating system documentation set.

SOFTWARE PRODUCT SERVICES

A variety of service options are available from Compaq. For more information, contact your local Compaq office.

SOFTWARE WARRANTY

This software is provided by Compaq with a 90 day conformance warranty in accordance with the Compaq warranty terms applicable to the license purchase.

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