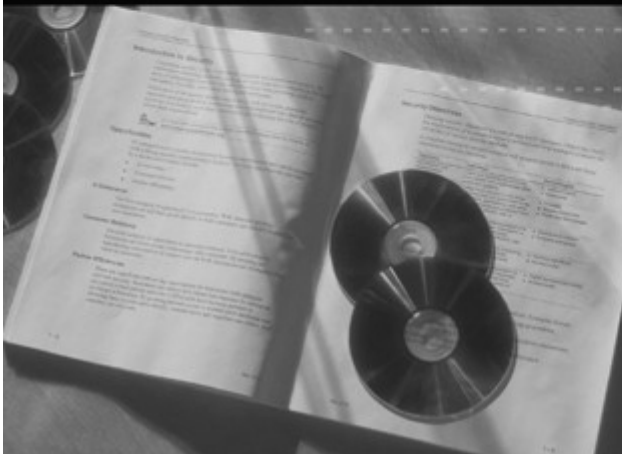


*OpenVMS System Troubleshooting
for System Managers*

Student Guide

Training

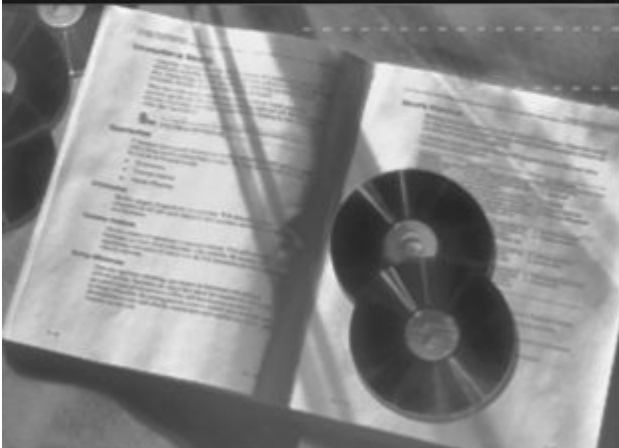


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*OpenVMS System Troubleshooting
for System Managers*

Student Guide

Training



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OpenVMS System Troubleshooting for System Managers

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March 2000

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Learning Check

Learning Check Answers

Acronym List

Appendix A - Setting Up a Remote Print Queue on a Terminal Server

Introduction

This section describes the contents of the *OpenVMS System Troubleshooting for System Managers* course and suggests ways in which you can most effectively use the materials. This section discusses the following topics:

- Course description
- Intended audience
- Prerequisites
- Course goals
- Course nongoes
- Course resources
- Course organization
- Module organization
- Course conventions

Course Description

This course uses lectures, case studies, and laboratory exercises to provide experienced OpenVMS system and network managers with problem prevention and troubleshooting techniques designed to improve system availability.

This course presents troubleshooting methodology to diagnose and correct problems in any circumstance. The course also discusses tools that can be useful in OpenVMS system troubleshooting situations and how to ensure that the system is prepared for troubleshooting when problems occur.

Advanced concepts enhance your understanding of how OpenVMS works in several areas relevant to system troubleshooting. There is a heavy emphasis on practical laboratory exercises designed to allow you to apply the troubleshooting methodology to real problems.

The techniques taught in this course apply to all OpenVMS Alpha and OpenVMS VAX systems running the OpenVMS operating system at Version 7.2, including workstations and OpenVMS Cluster systems.

Intended Audience

This course is intended for experienced OpenVMS system and network managers.

Prerequisites

You should be able to perform the following tasks before enrolling in this course:

- Perform system startup for a single node or an OpenVMS Cluster node.
- Use OpenVMS utilities such as: BACKUP, INSTALL, SYSGEN, and MONITOR.
- Write and understand DCL command procedures.
- Create and modify print queues.

Course Goals

To diagnose and correct OpenVMS system problems, you should be able to:

- Apply a troubleshooting methodology to isolate and define system problems in a clustered, networked environment.
- Use appropriate OpenVMS tools and utilities to troubleshoot the system environment.
- Use controls to prevent problems and prepare the system for troubleshooting unexpected problems.

Course Nongoals

This course does not address all possible system problems, but rather uses a select group of problems to demonstrate troubleshooting techniques.

This course does not address the following topics:

- General OpenVMS or OpenVMS Cluster system management
- OpenVMS operating system internals
- Interpreting system dump files

Course Resources

You must have access to an OpenVMS Cluster system, including a terminal server and printer, while you do the laboratory exercises. You also need the following additional resources to complete this course:

- *OpenVMS System Manager's Manual*
- *OpenVMS System Management Utilities Reference Manual*
- *OpenVMS VAX System Dump Analyzer Utility Manual*
- *Guidelines for OpenVMS Cluster Configurations*
- *OpenVMS Cluster Systems*
- *DIGITAL OpenVMS System Messages: Companion Guide for Help Message Users*
- *VAX/VMS Internals and Data Structures*
- *OpenVMS AXP Internals and Data Structures*
- *OpenVMS Alpha Upgrade and Installation Manual*
- *OpenVMS VAX Upgrade and Installation Manual*
- *DECams User's Guide*
- *DECnet-Plus for OpenVMS Introduction and User's Guide*
- *DECnet-Plus for OpenVMS Network Management*

Some of these documents are supplied with the student package; the rest should be available as reference in the classroom.

Course Organization

In this lecture/lab course, you attend both lecture sessions and laboratory sessions. Lecture sessions consist of instructor presentations and class discussions. Laboratory sessions consist of instructor demonstrations or directed individual and/or team study. You should try to complete the written and laboratory exercises during the laboratory sessions.

Your instructor may provide you with a prerequisite test. Take the prerequisite test before beginning the course to find out whether you meet the prerequisites.

Module Organization

Each module in the *Student Guide* consists of:

- An **introduction** that describes the purpose of the module, provides motivation for mastering its objectives, and outlines its contents.
- One or more **objectives** that identify the skills taught in the module. Objectives are designed to focus your study efforts on a selected number of skills.
- A list of **resources** you may need to complete the unit. Some of these resources are distributed with this course; your instructor should give you access to the others.
- The module **text** that consists of:
 - Descriptive text organized in a list format
 - Illustrations that clarify the relationships among various elements of OpenVMS Cluster system or summarize steps of a particular process
 - Tables that present information in a summary form
 - Examples containing sample listings from actual interactive sessions
 - A module **summary** that reviews important concepts and skills taught in the module.

Course Conventions

The following table describes the conventions used in the listings and command tables of the *Student Guide*.

Convention	Meaning
Ctrl/X	Press and hold the key labeled Ctrl while you press another key (X). Many control keys have special meanings.
UPPERCASE	In commands, uppercase characters indicate words you type exactly as they appear. For example, you would type the following commands as they appear: <pre>\$ DIRECTORY \$ TYPE LOGIN.COM</pre>
lowercase	Lowercase characters represent elements that you must replace according to the description in the text. For example, you must follow certain rules when you replace file-spec in the following example: <pre>\$ TYPE file-spec</pre>
Ellipsis (...)	Horizontal ellipses indicate that you can enter additional parameters, values, or information. For example, you can enter any number of file specifications in the following example: <pre>\$ TYPE file-spec, ...</pre> Vertical series of periods or ellipses mean that not all of the data that the system would display in response to the particular command is shown, or that not all the data a user would enter is shown. <pre>\$ TYPE MYFILE.DAT . . . \$</pre>
Square brackets ([]) and braces ({})	Square brackets indicate that the enclosed item is optional. (Square brackets are not optional, however, in the syntax of some file specifications.) For example, the logical name is optional in the following command: <pre>\$ MOUNT/FOREIGN \$TAPE1 [logical-name]</pre> Braces indicate that you must select from the included items.
DEFINE SET	The use of the means to use either the first command or the second command. This may be device specific. On some devices the command is DEFINE and on others SET.

Dependable Systems Overview

Module 1

Introduction

The impact of a computing system component failure can range from merely inconveniencing certain users, to the temporary loss of productivity and revenue, to harming the organization's long-term financial health or endangering public safety.

As organizations become more dependent on computing systems, the role of the system manager in providing dependable systems increases. The system manager's responsibilities may include:

- Designing a cost-effective, dependable system
- Establishing procedures and controls to prevent problems
- Troubleshooting and resolving system problems

Objectives

To provide dependable systems, you should be able to:

- Describe dependable system concepts.
- Describe a method of troubleshooting system problems.
- Describe OpenVMS system messages.
- Use OpenVMS troubleshooting tools.

Resources

- *OpenVMS VAX System Dump Analyzer Utility Manual*
- *OpenVMS System Messages: Companion Guide for Help Message Users*

Dependable Systems

Overview

A dependable computing system is one that can be counted on to provide services to users when those services are needed.

To participate in decisions regarding system configuration, you should be able to describe the levels of system dependability requirements.

This section discusses:

- System dependability categories
- System problems

System Dependability Categories

Categories of Dependability

Different categories of system dependability provide for different business needs. These include:

- Conventional computing systems
- Highly available computing systems
- Mission-critical computing systems
- Disaster-tolerant computing systems

Conventional Computing Systems

Conventional computing systems provide reliable service during specified hours. Infrequent service interruptions and downtime during other hours for backup and maintenance are expected.

Business example: A computer system that provides office automation for a department of a large corporation. The system consists of a two-CPU OpenVMS Cluster. Daily and weekly backups of files to tape are performed and **stored off-site**. If service is interrupted by power failure or component failure, the department is prepared to function without the service for a limited period. In the event of a disaster, the department will use the limited facilities of a backup hot site and resort to manual operations.

Highly Available Computing Systems

Highly available computing systems provide uninterrupted computing services during essential time periods. This requires redundant hardware and a backup power supply. Disk backup and routine maintenance are performed during non-business hours.

Business example: Business functions that require uninterrupted computing services, either during essential time periods, or during most hours of the day and most days of the week throughout the year. An automobile registration system that must always be available during business hours could be built using an OpenVMS Cluster with shadowed disks and an uninterruptible power system. During non-business hours, the system can be shut down for maintenance and disk backup. In the event of a disaster, the system can be established at a hot backup site within 16 hours.

Mission-Critical Computing Systems

Mission-critical computing systems provide for functions where the business's financial goals depend directly on how well its computing systems support the firm's applications. This may require fault-tolerant computing systems.

Business example:

- A telephone catalog sales company requires that customers can call in orders 7 days a week, 24 hours a day.
- The part of the automobile registration system that allows police officers to radio in license numbers for registration checking.

Disaster-Tolerant Computing Systems

Disaster-tolerant computing systems provide for functions that must be immune from disasters such as earthquakes, fires, floods, hurricanes, power failures, and acts of terrorism. This requires geographically separated, redundant hardware configurations.

Business example: The control system for a nuclear power plant.

System Problems

Classifying System Problems

System problems can be classified according to their cause:

- Environmental
- Hardware failure
- Software failure
- Human errors

Environmental Problems

Environmental problems include:

- Power fluctuations and loss
- Temperature
- Air quality
- Physical security

Hardware Problems

All hardware eventually fails due to friction, metal stress, and other factors.

Mean-time-between-failures (MTBF) is the average time that passes before a computing component fails such that remedial action is required.

To reduce the impact of hardware failure:

- Buy reliable hardware.
- Provide correct maintenance and environmental conditions.
- Provide redundancy. Avoid a single point of failure.
- Anticipate failures and replace or service equipment before it fails.

Software Problems

Theoretically, software could be built that would not fail.

Human Errors

The keys to minimizing human errors are:

- Training (including documentation and practice)
- Making the system easy to use

Handling Problems

Even the best managed systems cannot avoid all problems. Good problem management can minimize the impact of the problem on the business.

- Detect problems as soon as possible. Have an established procedure for problem reporting.
- Prepare for troubleshooting by installing the appropriate tools.
- Follow good troubleshooting techniques.
- Prevent problems from recurring.

Troubleshooting Methodology

Overview

When a system problem occurs, the system manager must apply a systematic method to solving the problem.

A suggested troubleshooting method consists of nine steps:

1. Define the problem.
2. Gather information about the problem.
3. Analyze and interpret the information.
4. Propose a solution, or refer the problem to the responsible person.
5. Verify the solution.
6. Clean up any parameters or files created for testing.
7. Reverify the solution.
8. Document the problem and archive the solution.
9. Investigate methods of preventing the problem from occurring again.

These nine steps are discussed in this section.

Step 1: Define the Problem

Purpose

The problem must be defined exactly before it can be analyzed and explained.

- The following is not a helpful problem definition:
“My files will not print.”
- A clearer problem definition would be:
“The printer in my office jams every time I try to print a file.”

It is important to **define the problem** without assuming what caused the problem.

For example, defining the problem as “the printer is broken” when files are not printing directs attention to the printer as the source of the problem when, in fact, it may be that the queue is the problem.

What to Do

When you encounter a system problem, ask the following preliminary questions of yourself or the user who reported the problem:

- What was the user trying to do when the problem occurred?
- What command was entered?
- What result was obtained?
- Is the problem accompanied by one or more error messages? What are the exact messages? In what order are they displayed?
- In the event of a hardware error (such as a printer problem), are any warning lights on?

Document the Process

As you ask questions and gather information about the problem, write the answers down.

This information is helpful to you when you analyze the information, and it saves time for other people to whom you may later escalate the problem.

Step 2: Gather Information

Purpose

After you have a clear problem statement, gathering additional information helps you narrow both the scope of the problem and the possible causes.

You may need to gather information several times throughout the process to isolate the source of the problem.

Relate Problem to System Changes

It is most important to know what changes have been made to the system and when they were made.

- Has a new layered product been installed?
- Have system parameters been changed?
- Was the system just reinitialized?
- Has new hardware been installed?

Questions to Ask

The following questions can guide you in gathering information about the problem:

- What system or systems are involved?
- What preceded the problem? What were the previous operations you performed before you detected the problem?
- What was happening on the system at the time the error occurred?
- What operation were you performing when the error occurred?
 - Can you relate the error to a system application, utility, or command?
 - Does the application utility or command have limitations or restrictions?
- Has this happened before, or is this the first time you have noticed the problem?
- When did the error occur? Watch for cyclic peak periods such as start of day, noon, end of day, and overnight batch runs.
- What is the scope of the problem: system, cluster, LAN, WAN?
- What applications are affected?

Step 3: Analyze and Interpret Information

Purpose

You may need to analyze and interpret information repeatedly as you gather more specific information about the problem you are solving. Continual information throughout the troubleshooting process, followed by analyzing and interpreting the information helps you isolate the source of the problem and eventually solve the problem.

Analyze the Information

Group the information into the following four categories to get a clear picture of the problem. You may need to reword the sample questions to fit your situation, but you should attempt to find information for each category.

Category	Sample Question to Ask
What	What do we observe?
When	When is the problem observed?
Where	Where is the problem observed?
Extent	How serious or extensive is the problem?

Interpret the Information

To interpret your data, establish a basis for comparison. Evaluate the elements of information and the relationships among the elements to get an understanding of the problem.

- Determine what conditions are required to cause the problem to happen again.
- Try to identify a similar situation that could experience the same problem, but does not experience it. Then ask yourself, what is different about that other situation? Asking this question makes it possible to identify the factors that are particular to the problem.
- Another technique is to ask, "What has changed?" Look at the differences between the problem situation and the situation that does not have the problem, and determine whether any of these differences represents something that has changed.
- Try to make the problem move. Have the user log in to another node, and see if the same thing occurs. What is different on that node, and what is the same?
- If you are unable to replicate a problem, you will probably not be able to find a solution.
 - Write a problem report that includes all relevant information.
 - Save the report to use if the problem happens again.
- Try to reduce the situation to the simplest set of circumstances that will still demonstrate the problem.
- You may discover that there is more than one problem, requiring more than one solution. Stay focused! Solve one problem at a time.

Example: Interpreting Information

Consider two identical printers connected to the same computer system. The printers are set up the same way, and they are located side by side. The paper in printer A jams frequently, but the paper in printer B rarely jams. What is different about the two printers?

Investigation might reveal that printer B always prints on plain paper, but printer A is often loaded with hole-punched paper. Most of the jams occur when hole-punched paper is used. It is more important to fan hole-punched paper before loading. Because various people load the printer, the paper is not always fanned correctly.

Step 4: Formulate and Apply a Proposed Solution

Purpose

Use the information you have gathered to formulate a proposed solution to the problem.

Implement the solution, if appropriate.

What to Do

At this step, you should do one or more of the following:

- Propose a solution to the problem.
- Investigate the solution further by testing other relationships.
- Apply the proposed solution or escalate the problem for resolution.
- Consider installing a temporary solution or workaround.

Propose a Solution

After you have analyzed and interpreted the information, you may be able to propose a specific solution:

- New solution
- Known solution

Investigate the Proposed Solution

After you formulate a proposed solution, investigate the solution by looking for other relationships.

If *X* is the problem, then *Y* should be true/false.

For example, if you think a user in group A cannot print a file on a print queue because the queue protection only allows a user in group C to print the file, then:

- Test to see if another user in group A can print to the queue. If the result of this test is negative, your proposed solution is supported.
- Test to see if a user in group C can print to the queue. A positive result supports the proposed solution.

Apply the Proposed Solution

Implement the solution. For example change the protection on the queue to allow world access.

Escalate the Problem

If the required solution is beyond the bounds of your authority or expertise, you may need to seek help from another person.

An escalation process should be in place and available to all personnel who are responsible for system operations. A listing of who to contact should be part of the standard operating procedure for any operations center.

Temporary Solutions

If you cannot solve a problem quickly and system availability is critical, you may have to implement a temporary solution that enables the system to remain running while allowing you to work on the problem.

These temporary measures are not ideal solutions and may cause a decrease in system performance. However, for most users, decreased service during the repair phase is preferable to no service at all.

Step 5: Verify the Solution

Purpose

Verify your solution to make sure that it explains every aspect of the observed problem. Verification is possible in most problem situations.

What to Do

Attempt to reproduce the problem under the same circumstances, and make sure the problem does not occur.

Attempt to reproduce the problem under slightly different circumstances. For example, test the solution from both a privileged and non-privileged account.

Does the solution survive system initialization?

- The best way to determine this is to initialize the system.
- In many cases, you may not be able to initialize the system to test your solution.
- Try to ascertain that the change is permanent.
- Make a note to test the solution after the next system initialization occurs.

If the problem occurs after the proposed solution has been implemented, go back to investigating the problem.

Example: Verifying a Problem Solution

After changing the protection on the queue to allow all users access to the queue:

- Check to make sure that non-privileged users from groups A, B, and C can print to the queue.
- Check to make sure the change will survive system initialization.

Step 6: Clean Up

Purpose

After you solve a system problem and verify the solution, clean up the system.

This step ensures that any parameters or tools you used in solving the problem do not interfere with the operation of the system.

What to Do

To clean up the system:

- Remove any solutions that were temporarily installed or enabled for troubleshooting.
- Delete test files.

Step 7: Reverify the Solution

Purpose

After you clean up temporary test facilities and solutions you used to solve the problem, confirm that your solution is still correct.

It is possible that some of the tools you used for testing masked the problem.

What to Do

Attempt to create the problem again under the same and slightly different circumstances.

Step 6 and step 7 should be done together.

- Remove one test file or temporary solution
- Test

Further Actions

If the proposed solution has solved the problem, you should:

- Cancel any requests you may have made for service from outside vendors.
- Notify users that the problem has been corrected.

If the solution does not solve the problem, you should:

- Gather more information.
- Analyze and interpret the data again.

Step 8: Document the Problem

Purpose

Keeping records of problem solutions and the processes that led to those solutions can provide insight to future system problems.

If you keep a log of the troubleshooting operation, you will find it easy to document the solution.

What to Do

Include the following information in your documentation:

- When the problem occurred
- Symptoms of the problem
- Explanation for its occurrence
- How you solved the problem
- Tools used to solve the problem
- Temporary means put in place to enable users to work while the problem was being solved

Step 9: Plan to Avoid or Handle Future Occurrences

Purpose

After the problem is solved and the systems are fully available, take steps to prevent the same problem from interrupting service again. If this is not feasible, prepare to recognize and solve the problem quickly.

What to Do

Study the problem and its cause to determine if you can do something to prevent the problem from occurring again.

- Software solution
- Hardware solution
- Manual control or training

If prevention is not possible or too expensive, prepare yourself and at least one other person to recognize and handle the problem.

OpenVMS System Messages

Overview

The OpenVMS operating system provides a centralized error message facility. When you enter a command at the terminal or execute an image that results in an error, the system locates the message associated with the error and displays it. The system also sometimes generates a message when a command has completed successfully.

You can get more information on system messages through online help.

This section discusses OpenVMS system messages.

Format of OpenVMS System Messages

Most messages displayed by the OpenVMS operating system have the following format:

- Main message
%FACILITY-L-IDENT, message-text
- Secondary message
-FACILITY-L-IDENT, message-text

where:

- FACILITY specifies the abbreviated name of the software component that issued the message.
- L shows the severity level of the condition that caused the message.
- IDENT is a symbol of up to 15 characters that represents the message.
- Message-text explains the cause of the message.

Some OpenVMS facilities produce messages with a slightly different format.

Example: Error Message

In the following error message, the main message is a warning (W) and the secondary message is an error (E).

```
$ TYPE MYFILE.DAT
```

```
%TYPE-W-SEARCHFAIL, error searching for DISK01:[SMITH]MYFILE.DAT; -RMS-  
E-FNF, file not found
```

Severity Levels

The following table summarizes the severity levels of OpenVMS system messages.

This code...	Means ...
S (Success)	The system successfully performed your request. In some cases, the command processing continues after the message is issued.
I (Information)	The system performed your request. The message provides information about the process.
W (Warning)	The command may have performed some, but not all, of your request. The message may suggest that you verify the command or the program output.
E (Error)	The output or program result is incorrect, but the system may attempt to continue execution.
F (Fatal)	The system cannot continue to execute the request.

Accessing Message Descriptions from Online Help

In OpenVMS Version 5.5 and higher, online message help is included as part of the main help library.

Use the following command to access a message description:

```
$ HELP/MESSAGE ident
```

The OpenVMS installation kit includes an optional online help version of the *DIGITAL OpenVMS System Messages: Companion Guide for Help Message Users*. Because the system message online help is optional, the document provides information on how to add or delete it.

Example: Message Description

The following example displays the help information for a message with the identification ACCVIO.

```
$ HELP/MESSAGE ACCVIO
```

```
ACCVIO, access violation, reason mask='xx', virtual
    address='xxxxxxxx', PC='xxxxxxxx', PSL='xxxxxxxx'
Facility:  TPU, DEC Text Processing Utility (DECTPU)
Explanation: An internal DECTPU failure occurred.
User Action: Contact a Digital support representative.
Press RETURN to continue ...
```

OpenVMS Troubleshooting Tools

Overview

The Error Log utility is a system management tool that selectively reports the contents of one or more error log files.

The System Dump Analyzer is a system management tool that is used to:

- Interpret the contents of the system dump file
- Copy the contents of the dump file to another file
- Analyze the running system

The system and network manager is responsible for:

- Maintaining the error log file and using the Error Log utility to detect hardware problems
- Making sure that the system writes a dump file whenever the system fails, that the dump file is large enough to contain all the information to be saved, and that the dump file is saved for analysis

Reading system dump files is an advanced topic that is covered in a specialized course.

This section discusses:

- Error Logging facility
- Operator log files
- System bugchecks
- System dump files
- Capturing dump files on systems with limited disk space
- Using the System Dump Analyzer to analyze a crash
- Using the Crash Log Utility Extractor

Error Logging Facility

Components

The Error Logging facility includes:

- Executive routines that detect errors and events and write relevant information into error log buffers in memory
- A process called ERRFMT, which starts when the system is booted
- Emptying of the error log buffers
- Formats standard error messages
- Storing the formatted information in a file on the system disk
- The Error Log utility, which is used to selectively report the contents of the error log file

Events Recorded

The OpenVMS operating system records several categories of events.

This category...	Includes these events ...
Errors	Device errors, device timeouts, machine checks, bus errors, memory errors, asynchronous write errors, undefined interrupts, and bugchecks
Volume changes	Volume mounts and dismounts
System events	Cold startups, warm startups, system failure startups, messages from the Send Message to Error Logger (\$SENDERR) system service, and time stamps

Hardware Types

The Error Log utility functions with most OpenVMS supported hardware, such as:

- CPUs
- Disks
- Tape drives
- Some communications devices

Error Log Buffers

The routines that detect errors and events write the information into error log buffers.

- Error log buffers are located in nonpaged pool in system space.
- The information in the error log buffers is written to the error log file by the ERRFMT process.
- Error log buffers are explicitly copied to the system dump file when the system crashes.
- The number of error log buffers and the size in pages are controlled by the following system parameters:
 - ERRORLOGBUFFERS
 - ERLBUFFERPAGES
- A burst of errors may fill up the buffers faster than the ERRFMT process can remove them. These error messages are lost.

Error Log File

The OpenVMS operating system automatically records device and CPU error messages in the error log file SYS\$ERRORLOG:ERRLOG.SYS.

The error log file increases in size and takes up space on the system disk until it is explicitly renamed or deleted.

Run a command procedure periodically to:

- Rename the current copy of the error log file to a file named, for example, ERRLOG.17-DEC-95
- Optionally back up the renamed error log file to off-line media
- Optionally delete the renamed error log file

**Note**

Not all hardware failures give warning error counts.

Example: Displaying Device Errors

Use the SHOW ERROR command to display device errors.

```
$ SHOW ERROR
```

Device	Error Count
PEA0:	15
\$1\$DUA1: (HSC01, HSC02)	1
\$1\$DUA4: (HSC01, HSC02)	3
\$1\$DUA10: (HSC01, HSC02)	3
\$1\$MUA0: (HSC01, HSC02)	2923
\$1\$MUA3: (HSC01, HSC02)	3901
\$1\$MUA1: (HSC02, HSC01)	3179
\$1\$MUA2: (HSC02, HSC01)	3806
\$1\$DUA8: (HSC02, HSC01)	17

The SHOW ERROR command only lists errors accumulated by one OpenVMS Cluster node and only the errors accumulated since the last time the system was booted.

Error Log Utility Reporting

To selectively report the contents of an error log file, use the DECEvent command:

```
$ DIAGNOSE [/qualifier(s)] file-specification
```

Example: Display from DIAGNOSE/FULL (Alpha)

The following is the output from an DIAGNOSE/FULL command.

```
***** ENTRY 1
*****

Logging OS              1. OpenVMS
System Architecture      2. Alpha
OS version              V7.2
Event sequence number    1583.
Timestamp of occurrence   18-JAN-1999 09:21:18
System uptime in seconds  58004.
Error mask              x00000000
Flags                   x0001 Dynamic Device Recognition
Host name               COGENT

Alpha HW model          DEC 3000 Model 400
System type register     x00000004 DEC 3000
Unique CPU ID           x00000002
mpnum                   x000000FF
mperr                   x000000FF

Event validity           -1. Unknown validity code
Event severity           -1. Unknown severity code
Entry type              100.
Major Event class        3. IO Subsystem
IO Minor Class           1. MSCP
IO Minor Sub Class       5. Logged Message
---- Device Profile ----
Vendor
Product Name            RAID 0 - Host Based
Unit Name               COGENT$DPA
Unit Number             10.
Device Class            x0001 Disk

---- IO SW Profile ----
VMS DC$_CLASS           1.
VMS DT$_TYPE            175.
```

---- MSCP Logged Msg ----

Logged Message Type Code 22. RAID Message
RAID Event Type 8. Remove Member
Distinguished Member 0.
Member Index 1.
RAID Urgency 4. Global Disk Error
RAID Status x00180009 Bit 00 - Reduced
 Bit 03 - Striped
 Bit 19 - FE Dis FE
 Bit 20 - BC Buff Copy Off
RAIDset Name KGB

Operator Log File

Location

The operator log file is located in the SYSS\$MANAGER directory.

Messages Recorded in the Operator Log File

The following types of messages are recorded in the operator log file:

- Initialization of the operator log file
- Status reports for devices attached to the system
- Operator terminals enabled and disabled
- Volume mounts and dismounts
- User requests and operator replies
- Changes to system parameters through the System Generation utility
- Security alarm messages
- DECnet status messages

Searching the Operator Log

You can use the DCL SEARCH command to search one or more files for specified strings and display the lines containing those strings.

This command is especially useful when searching for a problem.

- Format:

SEARCH file-specification[,,,] search-string[,,,]

- Parameters:

- *file-specification* specifies one or more files to be searched.
- *search-string* specifies the character string to be located.

An example is the use of the command to search OPERATOR.LOG for messages concerning the job controller or queue manager.

```
$ SEARCH SYS$MANAGER:OPERATOR.LOG/WINDOW=5 -  
_$ QUEUE_MANAGE, JOB_CONTROL
```

The qualifier /WINDOW=*n* specifies the number of lines to be displayed; *n*=5 is an appropriate value.

System Bugchecks

Types of Bugchecks

When the OpenVMS operating system detects an internal inconsistency, such as a corrupted data structure or an unexpected exception, it generates a bugcheck.

- If the inconsistency is not severe enough to prevent continued system operation, the bugcheck is nonfatal and results in an error log entry.
- If the error is serious enough to jeopardize system operation and data integrity, a fatal bugcheck is generated. This typically results in aborting normal system operation (crash), recording the contents of memory to a dump file for later analysis, and rebooting the system.

System Dump File

Contents of the System Dump File

When the operating system fails, the OpenVMS operating system writes to the system dump file the contents of the following:

- Error log buffers
- Processor registers
- Physical memory

Uses for the System Dump File

Use the system dump file to:

- Investigate the cause of a system crash
- Investigate system hangs

Enabling the System Dump File

The OpenVMS operating system writes the contents of memory into the system dump file when the operating system fails, provided:

- The system parameter DUMPBUG is set.
- There is adequate space for the dump file.

Example: Directory Listing of System Dump File

The following example shows the directory listing of a system dump file.

```
VRR00M> DIRECTORY/FULL SYS$SYSTEM:SYSDUMP.DMP
```

Directory SYS\$SYSROOT:[SYSEXE]

SYSDUMP.DMP;1 File ID: (2318,2,0)

Size: 327689/327690 Owner: [SYSTEM]

Created: 01-DEC-1998 14:09:11.93

Revised: 15-DEC-1998 14:12:04.66 (3)

Expires: <None specified>

Backup: <No backup recorded>

Effective: <None specified>

Recording: <None specified>

File organization: Sequential

Shelved state: Online

File attributes: Allocation: 327690, Extend: 0, Global buffer count: 0

 No version limit, **Backups disabled**, MoveFile disabled

Record format: Undefined, maximum 0 bytes, longest 0 bytes

Record attributes: None

RMS attributes: None

Journaling enabled: None

File protection: System:RWED, Owner:RWED, Group:RW, World:

Access Cntrl List: None

Total of 1 file, 327689/327690 blocks.

Where Is the Dump File Written?

The file SYSS\$SYSTEM:SYSDUMP.DMP is furnished as an empty file in the OpenVMS software distribution kit.

When the system fails, OpenVMS overwrites the contents of the previous dump file. If the system dump file is too small, all of the memory contents are not saved.

If there is no SYSDUMP.DMP, the system writes the contents of memory to the system paging file SYSS\$SYSTEM:PAGEFILE.SYS.

Saving the System Dump File

If you do not save the contents of the system dump file by copying the contents to another file, it will be overwritten the next time the system fails.

- Use the System Dump Analyzer (SDA) utility COPY command to save the contents of the system dump file in a file with another name.
- Format:
SDA> COPY output-file-specification
- Example:
SDA> COPY SYS\$CRASH:SAVEDUMP.DMP
- To save disk space, back up the copy of the dump file to tape and archive. Do **not** delete the original dump file.

SDA Commands at System Startup

SDA commands included in the site-specific startup procedure save the dump file and display crash information.

When invoked in the site-specific startup procedure, SDA executes the specified commands only if the system is booting immediately after a system failure.

Example: SDA Commands in System Startup Procedure

Include the following commands in the system startup command procedure to be executed only upon initialization following a crash:

```
$!  
$! Print dump listing if system just failed.  
$!  
$ ANALYZE/CRASH_DUMP SYS$SYSTEM:SYSDUMP.DMP  
COPY SYS_MAN_EXTRA:SAVEDUMP.DMP ! Save the dump file  
SET OUTPUT SYSDUMP.LIS ! Create a listing file  
SHOW CRASH ! Display crash info  
SHOW STACK ! Show current stack  
SHOW SUMMARY/IMAGE ! List all active processes  
SHOW PROCESS/PCB/PHD/REG ! Display current process  
SHOW SYMBOL/ALL ! Print system symbol table  
EXIT  
$!
```

Calculating the Correct Size for the System Dump File

To calculate the correct size for a full system dump file:

1. Enter the DCL SHOW MEMORY command to determine the total size of physical memory in pages on your system (M).

```
$ SHOW MEMORY
```

```
System Memory Resources on 15-JAN-1999 17:32:05.00
Physical Memory Usage (pages):  Total  Free  In Use Modified
Main Memory (160.00Mb)  327680  227196  92080  8404
```

```
.
.
.
```

2. Determine the number of error log buffers from the setting of the system parameter ERRORLOGBUFFERS (N) and the number of error log buffer pages from the setting of the system parameter ERLBUFFERPAGES (P).

```
$ RUN SYS$SYSTEM:SYSGEN
```

```
SYSGEN> SHOW ERRORLOGBUFFERS
```

Parameter Name	Current	Default	Min.	Max.	Unit	Dynamic
----------------	---------	---------	------	------	------	---------

ERRORLOGBUFFERS	4	4	2	64	Buffers	
-----------------	---	---	---	----	---------	--

```
SYSGEN> SHO ERLBUFFERPAGES
```

Parameter Name	Current	Default	Min.	Max.	Unit	Dynamic
----------------	---------	---------	------	------	------	---------

ERLBUFFERPAGES	2	2	2	32	Pages	
----------------	---	---	---	----	-------	--

3. Use the formula:

$$\text{SIZE} = M + (N * P) + 2$$

4. Example:

$$\text{SIZE} = 327680 + (4 * 2) + 2 = 327,690 \text{ pages}$$

16 disk blocks per page on Alpha systems.

1 disk block per page on VAX systems.

Capturing Dump Files on Systems with Limited Disk Space

Using the Paging File for the System Dump

If the SYS\$SYSTEM:SYSDUMP.DMP does not exist, the OpenVMS operating system writes the physical memory dump into SYS\$SYSTEM:PAGEFILE.SYS, which overwrites the contents of the paging file.

Set the system parameter SAVEDUMP (1=save) to save the information in the paging file related to the system crash when the system is rebooted.

- The paging file must be at least 1000 blocks larger than the minimum size for the dump file.
- On reboot, free the space occupied by the system dump file in the paging file or the system may hang.

Sample output from the SYSGEN SHOW SAVEDUMP command:

```
SYSGEN> SHOW SAVEDUMP
Parameter Name      Current Default  Min.    Max.    Unit Dynamic
-----
SAVEDUMP            0         0         0       1 Boolean
```

The DCL COPY command can also be used to copy the system dump file from the paging file to another file. This, however, does not free the space in the paging file and may cause the system to hang.

Copying the System Dump File from SYS\$SYSTEM: PAGEFILE.SYS

When the system dump file is written to the paging file, you must copy the file to another location when the system is rebooted to free the paging file space.

- Use SDA commands in the site-specific STARTUP.COM file.
- This frees the space in the paging file and allows the system to continue.

```
$ ANALYZE/CRASH_DUMP SYS$SYSTEM:PAGEFILE.SYS
.
.
.
COPY SYS$SYSTEM:SAVEDUMP.DMP      ! Save the dump file
                                   ! and release space in page file

EXIT
```

Systems with Large Memory and Small Disk Space

On systems with large memory and very limited disk space, saving the entire dump file may be impossible.

Set the system parameter DUMPSTYLE to 1 to set AUTOGEN to create a dump file large enough to save only a subset of the memory dump.

Using the System Dump Analyzer to Analyze a Crash

Overview

The System Dump Analyzer (SDA) utility extracts information from the system crash dump file (usually SYS\$SYSTEM:SYSDUMP.DMP) and presents it in a usable format.

Accessing the SDA (Alpha)

To access the System Dump Analyzer utility, type ANALYZE/CRASH *dumpfile* at the DCL prompt.

Example: Displaying Crash Information

Use the SHOW CRASH command at the SDA> prompt to display information about the most recent crash.

```
OpenVMS (TM) Alpha system dump analyzer
...analyzing a selective memory dump...
%SDA-W-NOTSAVED, SPT window not saved in the dump file
Dump taken on 15-JAN-1999 15:40:51.03
❶ INVEXCEPTN, Exception while above ASTDEL
SDA> SHOW CRASH
System crash information
-----
Time of system crash: 15-JAN-1999 13:47:10.54
Version of system: OpenVMS (TM) Alpha Operating System, Version V7.2
System Version Major ID/Minor ID: 3/0
VMScluster node: VRRROOM, a DEC 3000 Model 500
Crash CPU ID/Primary CPU ID: 00/00
Bitmask of CPUs active/available: 00000001/00000001
CPU bugcheck codes:
    CPU 00 -- INVEXCEPTN, Exception while above ASTDEL
-----
System State at Time of Exception
-----
Exception Frame:
-----
    R2 = FFFFFFFF 80885FB0 SYS$PEDRIVER_NPRW+05DB0
    R3 = 00000000 0000000A
    R4 = 61616161 61616161
    R5 = FFFFFFFF 80A556C0
    R6 = 66666666 66666666
    R7 = 77777777 77777777
    PC = FFFFFFFF 809F37CC
    PS = 20000000 00000804
❷ 809F37BC: ADDQ    SP, #X10, SP
    809F37C0: RET     R31, (R26)
    809F37C4: BIS     R31, R31, R0
    809F37C8: BIS     R31, #X0A, R28
    PC => 809F37CC: STL     R28, (R0)

    809F37D0: LDQ     R3, #X0008(SP)
    809F37D4: ADDQ    SP, #X10, SP
    809F37D8: RET     R31, (R26)
    809F37DC: 61616161
    PS =>
    MBZ SPAL  MBZ IPL VMM MBZ CURMOD INT PRVMOD
    0 20 000000000000 08 0 0 KERN 1 KERN
.
.
.
```

Example Notes: Displaying Crash Information

- ❶ The reason for the crash
- ❷ Code that was executing at the time of the crash. PC points to the current instruction.

Example: SDA Command SHOW SUMMARY/IMAGE

The following example shows the output of the SDA SHOW SUMMARY/IMAGE command.

```
$ ANALYZE/CRASH SYS$SYSTEM:SYSDUMP.DMP
OpenVMS (TM) VAX System dump analyzer
Dump taken on 15-JAN-1999 14:52:44.24
NETDLLERR, DECnet DataLink Layer detected a fatal error
SDA> SHOW SUMMARY/IMAGE
Current process summary
-----
Extended Indx Process name Username State Pri PCB  PHD Wkset
-- PID --
40800041 0001 SWAPPER      HIB  16 813545A0 81354400 0
40800044 0004 STARTUP    SYSTEM PFW  5 817EAE00 81E6AC00 777
      DSA0:[SYS17.SYSCOMMON.][SYSEXEC]VMOUNT.EXE;1
40800046 0006 CONFIGURE  SYSTEM HIB  9 817ECE00 81E22600 182
      DSA0:[SYS17.SYSCOMMON.][SYSEXEC]CONFIGURE.EXE;1
SDA>
```

Crash Log Utility Extractor (CLUE)

Overview

The Crash Log Utility Extractor (CLUE) is a utility for managing and examining system dump files. A history file lets you store information about previous system crashes.

Accessing CLUE

To access CLUE on an OpenVMS Alpha system:

- Start the System Dump Analyzer (SDA) utility.
- Enter CLUE at the SDA> prompt.

To access CLUE on an OpenVMS VAX system enter MCR CLUE at the DCL prompt.

Example: Accessing CLUE

The following example shows how to access CLUE on an OpenVMS Alpha system:

```
$ ANALYZE/CRASH SYS$SYSTEM:SYSDUMP.DMP
```

```
OpenVMS (TM) Alpha system dump analyzer
...analyzing a selective memory dump...
```

```
Dump taken on 15-JAN-1999 13:47:10.54
INVEXCEPTN, Exception while above ASTDEL
```

```
SDA> CLUE
CLUE Alpha - Type CLUE HELP for further Information
CLUE commands: CANASTA, CLEANUP, CONFIG, CRASH, DEBUG, ERRLOG, HELP,
               HISTORY,
               KPB, MCHK, MEMORY, PROCESS, SCSI, STACK, VCC, XQP
SDA>
```

If there is no valid dump, SDA returns an error message and drops back to the DCL prompt.

Displaying CLUE History Entries

On an OpenVMS VAX system, use the /DISPLAY command in CLUE to list the entries in the history file.

There is no equivalent command on an OpenVMS Alpha system.

```
$ MCR CLUE
```

#	Node	Time	Type	Process Name	Module	Offset
1	BROWNY	9-DEC-1998 13:56	OPERATOR	SYSTEM	UNKNOWN	0
2	BROWNY	16-DEC-1998 13:57	OPERATOR	SYSTEM_1	UNKNOWN	0
3	BROWNY	16-DEC-1998 07:12	OPERATOR	SYSTEM	UNKNOWN	0
4	BROWNY	15-DEC-1998 16:23	OPERATOR	_RTA1:	UNKNOWN	0
5	BROWNY	15-DEC-1998 15:36	OPERATOR	SYSTEM	UNKNOWN	0

```
CLUE> /DISPLAY
```

Displaying Crash Information Using CLUE (OpenVMS VAX)

From the CLUE_DISPLAY> prompt, use the SHOW CRASH command to display information about a selected system crash.

```
CLUE_DISPLAY >SHOW CRASH 1
```

```
#1 CRASH DATA:
```

BUGCHECK TYPE	INVEXCEPTN
TIME	10-DEC-1998 14:56:16.25
VMS VERSION	V7.2
Crash CPU ID / Primary CPU ID	0/0
Number of CPUs	1
Bitmask of CPUs active/available	00000001/00000001
Bitmask of bugchecking CPUs	00000001
Current Process Name	NONE

Press RETURN for more

```
CLUE_DISPLAY >
```

Displaying Crash Information Using CLUE (Alpha)

Use the CLUE CRASH command at the SDA prompt to display information about the most recent crash.

```
SDA> CLUE CRASH
```

Crashdump Summary Information:

Crash Time: 10-JAN-1999 13:47:10.54

Bugcheck Type: INVEXCEPTN, Exception while above ASTDEL

Node: VRR00M (Clustered)

CPU Type: DEC 3000 Model 500

VMS Version: V7.2

Current Process: NULL

Current Image: <not available>

Failing PC: FFFFFFFF 809F37CC

Failing PS: 20000000 00000804

Module: <not available>

Offset: 00000000

Boot Time: 3-JAN-1999

System Uptime: 2 02:48:48.54

Crash/Primary CPU: 00/00

Saved Processes: 24

Pagesize: 8 KByte (8192 bytes)

Physical Memory: 96 MByte (12288 PFNs)

Dumpfile Pagelets: 107821 blocks

Dump Flags: olddump,writecomp,errlogcomp,dump_style

EXE\$GL_FLAGS: poolpging,init,bugdump

Stack Pointers:

KSP = FFFFFFFF 825F1B68 ESP = FFFFFFFF 825F3000 SSP = FFFFFFFF 825EF000

USP = FFFFFFFF 825EF000

General Registers:

R0 = 00000000 00000FBA R1 = 00000000 00000000 R2 = FFFFFFFF FFFFFFFD

R3 = FFFFFFFF 8082F660 R4 = FFFFFFFF 825F1BC0 R5 = FFFFFFFF 825F1D28

R6 = FFFFFFFF 825F1D80 R7 = 20000000 00000804 R8 = 88888888 88888888

```

R9 = 99999999 99999999 R10 = AAAAAAAAAA AAAAAAAAAA R11 = BBBBBBBB BBBBBBBB
R12 = CCCCCCCC CCCCCCCC R13 = DDDDDDDD DDDDDDDD R14 = EEEEEEEE EEEEEEEE
R15 = EEEEEEEE EEEEEEEE R16 = 00000000 000001CC R17 = FFFFFFFF 825F1BC0
R18 = FFFFFFFF 825F1D80 R19 = FFFFFFFF 80804200 R20 = FFFFFFFF 8096E4B4
R21 = FFFFFFFF 8096E4B7 R22 = FFFFFFFF 809F378C R23 = FFFFFFFF 80822340

```

Press RETURN for more.

SDA>

On the Alpha system, the CLUE CONFIG command can be useful because it gives the sort of information that SHOW DEVICE would return from the console. For example:

SDA> CLUE CONFIG

System Configuration:

System Information:

```

System Type DEC 3000 Model 500 Primary CPU ID 00
Cycle Time 6.6 nsec (150 MHz) Pagesize 8192 Byte

```

Memory Configuration:

Cluster	PFN	Start PFN	Count	Range (MByte)	Usage
#00	0	256		0.0 MB - 2.0 MB Console	
#01	256	12032		2.0 MB - 96.0 MB System	

Per-CPU Slot Processor Information:

```

CPU ID 00 CPU State rc,pa,pp,cv,pv,pmv,pl
CPU Type EV4 P2.0/2.1 Halt PC 00000000 00000000
PAL Code 5.41 Halt PS 00000000 00000000
CPU Revision F001 Halt Code 00000000 00000000
Serial Number ..... Bootstrap or Powerfail

```

Press RETURN for more.

System Dump Analyzer Features

The System Dump Analyzer (SDA) has a new command, new features to existing commands, display changes, and other command changes.

New Features for Existing Commands

The following commands have new features and qualifiers:

- **SHOW CLUSTER /NODE=name**
- **SHOW CONNECTIONS /SYSAP /NODE=name**
- **SHOW LAN/CLIENT=name /DEVICE=name /UNIT=name**
- **SHOW LOCK/CACHED**
- **SHOW PAGE_TABLE /GPT /PT /SOS1 /S2 /SPTW**
- **SHOW PFN_DATA/ADDRESS=<PFN-entry-address>**
- **SHOW PROCESS/ADDRESS=pcb-address /INDEX=n /RDE=id /SEMAPHORE /THREADS /WORKING_SET_LIST**
- **SHOW RESOURCE/CACHED**
- **SHOW SUMMARY/THREAD**

Other SDA Command Changes

Other SDA command changes include:

- **Page table requests**
Certain page table requests require SDA to cover large virtual address spaces in small increments, looking for valid page table entries. This will noticeably slow your system. Try using a more narrow range of interest to prevent this.
- **Bugcheck usability changes**
An attempt has been made to make the dumps that were partially written when a system crashed more usable. This reduces the number of times SDA signals an incomplete dump file.
- **Bugcheck transition pages**
BUGCHECK no longer forces pages of virtual memory to be written into a dump file. Page table entries are not altered, and transition pages are treated as holes in address space that is inaccessible by SDA.

New SDA Command SET FETCH

The new SDA command **SET FETCH** sets the default size of data manipulated by the EXAMINE and the EVALUATE commands. SET FETCH has no qualifiers.

SDA Display Changes

The following commands have display changes:

- **SHOW CRASH**
This command's exception display is changed to use the new 64-bit signal array.
- **SHOW PFN_DATA**
The output from this command is converted to a two-line format to accommodate the expansion of virtual addresses from 32 bits to 64 bits. The expansion was also needed to display additional information.
- **SHOW PAGE_TABLE**
- **SHOW PROCESS/WORKING SET**
- **SHOW PROCESS/PHD**
- **SHOW PROCESS/PROCESS_SECTION_TABLE**

VAX Dump File Process

The OpenVMS VAX SDA now uses RMS file access to process the dump file. (Previously, it mapped the dump file into the working set.)

This change, however, has made some of the SDA commands noticeably slower.

A value of 16,000 is now sufficient for the system parameter virtual page count VIRTUALPAGECNT to analyze any size dump.

Summary

Concepts

Dependable Systems

- A dependable computing system is one that can be counted on to provide services to users when those services are needed.
- System problems can be caused by
 - Environmental problems
 - Hardware failure
 - Software failure
 - Human error

Troubleshooting Methodology

A suggested troubleshooting method consists of nine steps:

1. Define the problem.
2. Gather information about the problem.
3. Analyze and interpret the information.
4. Propose a solution, or refer the problem to the responsible person.
5. Verify the solution.
6. Clean up any parameters or files created for testing.
7. Reverify the solution.
8. Document the problem and archive the solution.
9. Investigate methods of preventing the problem from occurring again.

OpenVMS System Messages

- Most system messages follow a standard format.
- Online help provides more information on error messages.

OpenVMS Troubleshooting Tools

- The system dump file captures the contents of memory when the operating system experiences a fatal bugcheck.
- Nonfatal bugchecks write messages to the error log file.

Commands

OpenVMS System Messages

HELP /MESSAGE ident

DCL command to access a system message description.

OpenVMS Troubleshooting Tools

SHOW ERROR

DCL command to display device errors.

DIAGNOSE file-specification

DCL command to selectively report contents of an error log file.

SEARCH file-specification[,,,] search-string[,,,]

DCL command to search one or more files for specified strings.

ANALYZE/CRASH_DUMP file-specification

DCL command to invoke the System Dump Analyzer utility.

SHOW MEMORY

DCL command to display memory usage.

SHOW parameter-name

SYSGEN command to display parameter values.

Chapter Terms

availability

The percentage or amount of scheduled time that a computing system provides application service.

bugcheck

An internal inconsistency that the OpenVMS operating system cannot resolve. If a nonfatal bugcheck is declared, an error log entry is made. If the system cannot continue to run, a fatal bugcheck is declared and the system produces a crash dump.

fault tolerance

The ability of a computing system to withstand faults and errors while continuing to provide the required services. A high level of failover transparency is usually implied by this term.

mean-time-between-failures (MTBF)

The average time that passes before a computing component fails such that remedial action is required.

reliability

The ability of a computing system to operate without failing.

System Initialization Problems

Module 2

Introduction

During routine system operation, you may shut down and restart your system to perform various maintenance functions. User modifications to files on the system disk, hardware failures, etc., can cause the startup procedure to fail.

To correct the problem, you should be able to use the emergency startup procedures to reboot the system.

This module discusses how to identify problems when booting a standalone system. Cluster problems are discussed in Module 4.

The module also reinforces the idea of change management, which is one of the key concepts in this course.

Objectives

To handle and prevent system initialization problems, you should be able to:

- Describe system initialization concepts.
- Use emergency system initialization procedures and the standalone Backup utility.
- List the steps to follow in solving system initialization problems.
- Avoid system initialization problems.

Resources

- *OpenVMS VAX Version x.x Upgrade and Installation Manual*
- *OpenVMS Alpha Version x.x Upgrade and Installation Manual*
- *OpenVMS Alpha Internals and Data Structures*
- *VAX/VMS Internals and Data Structures*

System Initialization Concepts

Overview

System initialization, or booting, is the process of loading system software from the system disk into processor memory. Part of the initialization process is specific to the type of processor. Other parts are common across the entire family of computers. This section focuses on the common parts of the initialization process.

System initialization takes place in a series of steps or stages as different programs are executed. As each program executes, messages that provide information on how far the initialization process has progressed are written to the console.

If the initialization process fails, you must determine at what stage it failed so you can begin the troubleshooting process.

To troubleshoot system initialization problems, you should be able to describe the phases of system initialization which are discussed in this module.

Phases of OpenVMS System Initialization

Initialization Steps

OpenVMS system initialization occurs in a series of steps.

1. The console subsystem is CPU specific. Regardless of its implementation, the console subsystem performs the following tasks:
 - Initializes the CPU
 - Locates physically contiguous good memory
 - Loads the primary bootstrap image into memory and transfers control to it
2. The primary bootstrap program (APB for Alpha CPUs, VMB for VAX CPUs) runs standalone and performs the following tasks:
 - Sizes memory
 - Initializes context for the adapter and device unit (system disk) containing the secondary bootstrap program
 - Loads the secondary bootstrap and transfers control to it
3. SYSBOOT.EXE, the secondary bootstrap program (a file on system disk), runs standalone with memory management disabled and performs the following tasks:
 - Reads the system parameters, by default from [SYSn.SYSEXEX]ALPHAVMSSYS.PAR (VAXVMSSYS.PAR for VAX systems)
 - Lays out the system virtual address space based on the system parameters
 - Loads the system base image, SYS.EXE, into memory
 - Also loads the system device driver, port driver, auxiliary driver, SYS\$CPU_ROUTINES_xxyy (SYSLOA on VAX systems), and OpenVMS Cluster code
 - Turns control over to the EXE\$INIT routine in module INIT (EXE_INIT on VAX systems)
 - Displays the SYSBOOT> prompt during conversational boot

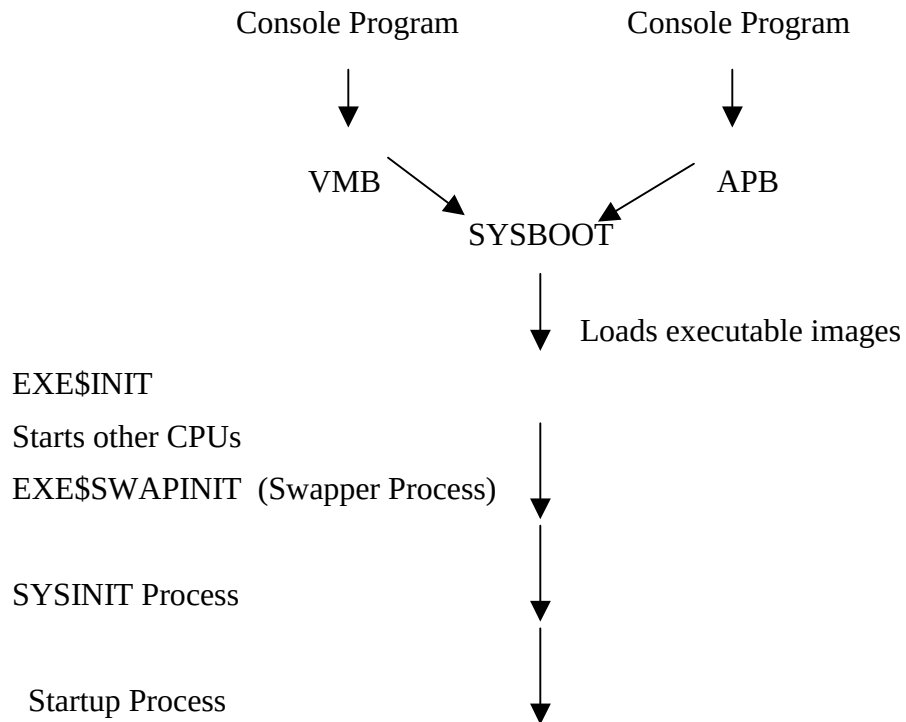
4. EXE\$INIT performs the following initialization tasks that must occur before process context is available:
 - Turns on memory management
 - Invokes initialization routines loaded by SYSBOOT.EXE
 - Initializes both the scheduler and memory management
 - Starts secondary CPUs
 - Runs the routine that starts the swapper
 - Displays the OpenVMS banner OpenVMS TM Alpha Operating System, Version V7.2
5. EXE\$SWAPINIT performs the following tasks:
 - Initializes paged pool and the pageable logical name database
 - Creates the SYSINIT process
6. SYSINIT.EXE performs the following tasks:
 - Loads RMS and other loadable images
 - Initializes the OpenVMS Cluster software for an OpenVMS Cluster node
 - Opens the swap and page files and records their extents
 - Opens Files-11 Extended QIO processor (XQP) as a global section
 - Loads the system message file
 - Creates the site-independent startup process
7. The startup process has a full process context and can execute DCL commands. It performs the following tasks:
 - Executes the site-independent SYS\$SYSTEM:STARTUP.COM
 - Creates OPCOM, job controller, and SMISERVER processes
 - Creates systemwide logical names
 - Runs SYSGEN to autoconfigure the I/O database
 - Installs the images specified in the VMSIMAGES.DAT file
 - Enables licenses
 - Executes the site-specific SYS\$MANAGER:SYSTARTUP_VMS.COM, and so forth
 - Enables logins

Sequence of Initialization Events

The following figure shows the sequence of OpenVMS initialization steps on different CPUs.

VAX 6000 Series

Alpha



Site-Specific Startup Command Procedures

The site-specific command procedures in order of execution are:

- SYCONFIG.COM
- SYLOGICALS.COM
- SYPAGSWPFILES.COM
- SYSECURITY.COM
- NET\$STARTUP.COM
- SYSTARTUP_VMS.COM

Use the site-specific command procedures to do the following:

- Start or enable batch and print queues.
- Set terminal speeds and other device characteristics.
- Create site-specific system logical names.
- Install additional privileged and shareable images.
- Load user-written device drivers.
- Mount volumes other than the system disk.
- Load the console driver.
- Start DECnet software.
- Start the software that runs the LAT protocol.
- Produce an error log report.
- Announce system availability.
- Load the operating systems for print servers.

Site-Specific Startup Dependencies

Follow these rules for the site-specific startup command procedure:

- Start the network before the LAT.
- Start print queues after the LAT.
- Check requirements for layered products.

Emergency System Initialization

Overview

The startup and login procedures provided by Compaq should always work; however, certain user interventions or hardware problems can cause them to fail. When this happens, you use the emergency startup procedures to boot the system.

When system files are accidentally deleted or corrupted, you use standalone Backup to restore the system disk and boot the system.

System disk software and hardware problems can make the entire system unavailable.

This section discusses:

- Performing a conversational boot
- Using SYSGEN commands during system initialization
- Performing a minimum system initialization
- Defining the console as the startup procedure
- Using standalone Backup to save and restore the system disk
- Handling system disk problems

Performing a Conversational Boot

When to Use Conversational Boot

Perform a conversational boot when you want to stop the boot procedure before it completes. Generally this is because of error messages during the boot.

The boot procedure pauses after it loads SYSBOOT.EXE and displays the SYSBOOT> prompt.

Conversational Boot Options

At the SYSBOOT> prompt, you can enter SYSGEN commands to do the following:

- Look at system parameter values.
- Change system parameter values.
 - Specify a minimum startup.
 - Specify another parameter file.
 - Specify another site-independent startup command procedure.
 - Define the console as the startup procedure so that you can control the final stages of the system initialization.
 - Turn on verify.

Processor-Specific Procedures

The procedures to perform a conversational boot are processor specific. See the documentation that was shipped with your system to find the procedures for a particular Alpha or VAX computer.

Examples

VAX 6000 series

```
>>> BOOT /R5=1 [device]
```

Alpha

```
>>> BOOT -FLAGS 0,1 [device]
```

Using SYSGEN Commands During System Initialization

SYSBOOT> Prompt

When you use a conversational boot, you access the SYSBOOT> prompt.

You can use a subset of the SYSGEN commands at the SYSBOOT> prompt.

SYSGEN Commands Commonly Used at the SYSBOOT> Prompt

Command	Description
CONTINUE	Resumes the boot procedure.
HELP	Displays a summary of the SYSBOOT commands.
SET	Establishes the value of a system parameter.
SET/STARTUP	Sets the name of the system startup command procedure. (The default startup procedure is SYS\$SYSTEM:STARTUP.)
SHOW	Displays current, default, maximum, and minimum values for specific system parameters. Displays, with appropriate qualifiers, characteristics of parameters grouped by categories.
USE	Specifies a parameter file to be used as a source of values. (You must enter the entire file specification, including device and directory.)

Performing a Minimum System Initialization

To perform a minimum system initialization, enter the following at the SYSBOOT> prompt:

```
SYSBOOT> SET STARTUP_P1 "MIN"
```

```
SYSBOOT> CONTINUE
```

Minimum Initialization Operations

A minimum system initialization performs the following operations:

- Starts the processes that control error logging, the job controller, and the operator's log
- Installs known images
- Defines the number of interactive users as 8
- Logs off

A minimum system initialization does not invoke the site-specific startup command procedures, nor does it automatically configure all devices

A minimum system initialization provides a DCL environment in which you can resolve problems with the site-specific startup command procedure. To continue resolving problems with the site-specific startup command procedure, log in to the system account or other privileged account.

System Processes at Minimum Boot

The following processes are active after a minimum system initialization:

- SWAPPER
- FASTPATH_SERVER
- ERRFMT
- OPCOM
- JOB_CONTROL

Resetting STARTUP_P1

The value of STARTUP_P1 is saved and affects future boot operations. After you resolve the problems with the startup command procedure and boot the system, you must reset the value to NULL.

To reset the value to NULL, run SYSGEN.

```
$ RUN SYS$SYSTEM:SYSGEN
SYSGEN> SET STARTUP_P1 ""
SYSGEN> WRITE CURRENT
SYSGEN> EXIT
```

Using the AUTOGEN.PAR File for System Parameters

If changes to system parameters have been made without using AUTOGEN, and the system does not initialize, you may be able to avoid restoring the system disk by using the AUTOGEN.PAR file.

Perform a conversational boot, and at the SYSBOOT> prompt enter the command USE SYS\$SYSTEM:AUTOGEN.PAR to instruct the system to use this file.

```
SYSBOOT> USE SYS$SYSTEM:AUTOGEN.PAR
SYSBOOT> SET STARTUP_P1 "MIN"
SYSBOOT> CONTINUE
```

Using the Default System Parameters

If you suspect that the reason your system does not initialize is because of changes to system parameters, try using the default system parameters to initialize the system.

Perform a conversational boot, and at the SYSBOOT> prompt, enter the command `USE DEFAULT` to instruct the system to use all the default system parameters.

Then boot the system minimally.

```
SYSBOOT> USE DEFAULT
```

```
SYSBOOT> SET STARTUP_P1 "MIN"
```

```
SYSBOOT> CONTINUE
```

In most cases, this allows the system to initialize.

Defining the Console as the Startup Procedure

Overview

You can resolve problems with the site-independent startup command procedure by defining the console as the startup procedure.

You can use this technique to:

- Reset a forgotten system password
- Perform a full backup or restore operation
- Use an alternate startup file

Defining the Console as the Startup Procedure

To define the console as the startup device:

1. Boot conversationally until you reach the SYSBOOT> prompt, and then enter.

```
SYSBOOT> SHOW/STARTUP
```

```
SYSBOOT> SET/STARTUP OPA0:
```

```
SYSBOOT> CONTINUE
```

The original startup setting is displayed and changed to be the console. The boot process continues through the SYSINIT process, and you will see the DCL prompt. The site-independent startup command procedure has not been executed.

This is an important problem-resolution method, often called “Booting OPA0.”

Be sure to go back to the figure of the initialization events and show where you are when you boot OPA0:

Restoring the System Startup

After the problems have been resolved, restore the site-independent startup command procedure as the startup command procedure:

```
$ RUN SYS$SYSTEM:SYSGEN
```

```
SYSGEN> SET/STARTUP SYS$SYSTEM:STARTUP.COM
```

```
SYSGEN> WRITE CURRENT
```

```
SYSGEN> EXIT
```

To run the site-independent startup command procedure:

```
$ reboot ! if that symbol has been defined
```

Using a Full-Screen Editor

If you use a workstation as a console, you can use an editor only in line mode when the system is booted to use OPA0:. The following procedure allows you to use a full-screen editor:

1. Perform a conversational boot of the workstation.
2. At the SYSBOOT> prompt:

```
SYSBOOT> SET/STARTUP OPA0:
SYSBOOT> SET STARTUP_P1 "MIN"
SYSBOOT> CONTINUE
```

The system boots with the console as the command procedure.

3. When you see the \$ prompt, do the following:
\$ SPAWN
\$ SET DEFAULT [SYS0.SYSCOMMON.SYSEXEC] ! Set default to the
directory
! containing startup.com
\$ @STARTUP ! This will boot the system minimum
ALPHA VAX
\$ MCR SYSMAN \$ MCR SYSGEN
SYSMAN>IO AUTO SYSGEN> AUTO ALL
SYSMAN>EXIT SYSGEN> EXIT
\$ DEFINE/SYSTEM DECV\$IGNORE_DECNET "TRUE"
\$ @SYSS\$MANAGER:DECV\$STARTUP
2. When DECV\$STARTUP.COM executes, log out of the workstation terminal so that DECwindows can start up on it.
3. When DECwindows starts on the workstation terminal, log in to the DECwindows session.
4. Use the full-screen editor to make modifications to the SYSTARTUP_VMS.COM command procedure.

5. Set startup back to the SYS\$SYSTEM:STARTUP.COM.
SYSGEN> USE CURRENT
SYSGEN> SET/STARTUP SYS\$SYSTEM:STARTUP.COM
SYSGEN> SET STARTUP_P1 ""
SYSGEN> WRITE CURRENT
SYSGEN> EXIT
6. Halt the system and reboot.

Using EDT from the Console

When the system is booted with the console as the startup command procedure, you can use the EDT editor in line mode only.

Using an editor in line mode is difficult when you are accustomed to using a full-screen editor. Keep a sheet of line editing instruction handy for emergency situations or for using a hardcopy terminal.

To avoid having to use the line editor, create a DCL command procedure in every system account.

```
$ CREATE SYS$LOGIN:EDTINI.EDT
```

```
SET MODE CHANGE
```

```
[Ctrl/Z]
```

Add the following commands to the system LOGIN.COM file to define a symbol to use the EDTINI.EDT file:

```
$ SET TERM/DEV=VT100
```

```
$ EDIT :== EDIT/EDT/COMMAND=SYS$LOGIN:EDTINI.EDT
```

Handling a Missing System Account Password

If you do not have access to any privileged account on the system and do not have the system account password, you cannot log in to a privileged account to change the system account password.

1. Do a conversational boot and define the console as the startup procedure.
7. At the \$ prompt, do the following to install the images needed to modify the user authorization file:


```
$ SET NOON
$ SET NOVERIFY
$ INSTALL := $INSTALL/COMMAND_MODE
$ INSTALL
INSTALL> ADD/OPEN/HEADER_RESIDENT/SHARED
      SYS$SHARE:SECURESHR.EXE
INSTALL> ADD/OPEN/HEADER_RESIDENT/PROTECTED/SHARED
      SYS$SHARE:SECURESHRP.EXE
INSTALL> ADD/OPEN/HEADER_RESIDENT/SHARED      SYS$SHARE:LIBRTL.EXE
INSTALL> EXIT
```
8. Use AUTHORIZE to modify the UAF.


```
$ SET DEFAULT SYS$SYSTEM      ! Set default to wherever the SYSUAF
                               ! is found
$ RUN SYS$SYSTEM:AUTHORIZE
UAF> MODIFY SYSTEM/PASSWORD= new-password
UAF> EXIT
```
9. Restore the original startup procedure.


```
$ RUN SYS$SYSTEM:SYSGEN
SYSGEN> SET/STARTUP SYS$SYSTEM:STARTUP.COM
SYSGEN> WRITE CURRENT
SYSGEN> EXIT
```
10. Run the startup command procedure.


```
$ @SYS$SYSTEM:STARTUP.COM
```

You will see error messages regarding the images already installed.

Using the Full Backup Utility at OPA0:

To use the full OpenVMS Backup utility when the system is initialized with the console as the startup command procedure, the images must be installed.

1. Perform a conversational boot:

```
SYSBOOT> SET/STARTUP OPA0:
```

```
SYSBOOT> CONTINUE
```

11. Configure the devices:

```
$ SET NOVERIFY
```

```
$ SET NOON
```

```
$ RUN SYSGEN
```

```
SYSGEN> AUTOCONFIGURE ALL
```

```
SYSGEN> EXIT
```

12. Install the images needed to run the Backup utility:

```
$ INSTALL :==$ INSTALL/COMMAND_MODE
```

```
$ INSTALL ADD SYS$SYSDEVICE:[SYS$SYSTEM]MOUNTSHR/OPEN/HEAD/PROT/SHARE
```

```
$ INSTALL ADD SYS$SYSDEVICE:[SYS$SYSTEM]DISMNTSHR/OPEN/HEAD/PROT/SHARE
```

```
$ INSTALL ADD SYS$SYSDEVICE:[SYS$SYSTEM]SECURESHRP/OPEN/HEAD/PROT/SHARE
```

13. Use the full Backup utility.

The primary advantage of using the full backup utility is that you can selectively restore a single file or group of files instead of restoring the entire save set as must be done with standalone Backup.

Hint: If you do not remember which images to install just issue the command to run the Backup Utility. The error messages will list the images that could not be found.

Using an Alternative Site-Independent Startup File

If the system does not boot because of problems with the site-independent startup file, use the SET/STARTUP command to boot the system with an alternative file.

Format:

```
SYSBOOT> SET/STARTUP file-spec
```

Example:

```
SYSBOOT> SET/STARTUP SYS$SYSTEM:XSTARTUP.COM
```

The file-spec must be the file specification of a startup command procedure on the system disk.

Displaying the Site-Independent Startup Command Procedure

To display the name of the current site-independent startup command procedure, use the SYSGEN command SHOW/STARTUP.

Format:

```
SYSBOOT> SHOW/STARTUP
```

Example:

```
SYSBOOT> SHOW/STARTUP
```

```
Startup command file = SYS$SYSTEM:STARTUP.COM
```

Using Standalone Backup to Save and Restore the System Disk

Standalone Backup

Standalone Backup is a subset of the Backup utility that is bootstrapped into main memory without the OpenVMS operating system.

You can use standalone Backup to resolve problems with system initialization caused by missing or corrupted system files.

Booting Standalone Backup

Use the menu system provided on the OpenVMS Alpha or VAX operating system distribution CD.

1. Run SHUTDOWN and halt the system.
14. Boot the system:
 - On OpenVMS Alpha systems, boot the distribution CD.
 - On OpenVMS VAX systems, boot the distribution CD from the SYS1 directory.
15. When standalone Backup finishes booting, it displays an identification message followed by the dollar sign prompt (\$).

Backing Up the System Disk to Tape

To back up the system disk to tape:

1. Boot standalone Backup.
16. Enter the BACKUP command in the following format:

```
$ BACKUP/IMAGE/VERIFY input-specifier: output-  
specifier/REWIND/LABEL=label)
```

where:

- *input-specifier* is the device name of the system disk.
- *output-specifier* is the device name of the drive that you want to hold the backup copy and the name of the save set.
- *label* is the volume label of the tape or tape cartridge.

Example:

```
$ BACKUP/IMAGE/VERIFY DUA0: MUA0:SYSDISK.BCK/SAVE_SET
```



Note

You should not make a backup copy of the system disk before you make any changes. This should be part of the change management system to be discussed at the end of this chapter.

Restoring the System Disk from Tape

To restore the system disk from tape, use the following procedure:

1. Boot standalone Backup.
17. Place the tape containing the backup copy of the system disk in the tape drive.
18. Enter the BACKUP command in the following format:
\$ BACKUP/IMAGE/VERIFY input-specifier/REWIND output-specifier
where:
 - *input-specifier* is the name of the tape drive and the save set.
 - *output-specifier* is the name of the system disk.

Example:

```
$ BACKUP/VERIFY MUA0:SYSDISK.BCK DUA0:
```

Handling System Disk Problems

Hardware Problems

If the problem is determined to be a system disk hardware problem, you can still initialize the system using the following steps:

1. Restore a backup copy of the system disk to a spare disk.
19. Boot the system using an alternate system disk.

Software Problems

If the initialization problem is caused by the accidental deletion or corruption of a system file, you may have to restore the entire system disk:

1. Use standalone Backup to make a copy of the current system disk on tape or on a spare disk.
2. Use standalone Backup to restore the previous backup of the system disk.
3. After the system is up and running, you can restore any system file that was changed from the system disk save set you made in step 1.

Alternative Method for Handling System Disk Software Problems

If you have another system running OpenVMS, you can use the full Backup utility to handle system disk software problems.

1. Connect the problem system disk to a running system.
2. Mount the problem disk and use DCL commands to search the disk for missing files.
3. After you fix the problem, connect the system disk to the original system.

The advantage to this method is that you can use the full Backup utility to restore selected files.

Resolving System Booting Problems

Overview

A system that does not boot is a serious problem. You must be able to isolate the source of the problem. If you determine the problem to be a hardware problem, you should notify Multivendor Customer Services.

You can use the methods previously discussed in this chapter to resolve software problems.

This section discusses isolating and resolving system initialization problems.

Isolating and Resolving System Initialization Problems

System Initialization Landmarks

Look for the following landmarks when the system is booting:

- Hardware diagnostics
- Boot prompt >>> (unless autostart)
- OpenVMS banner
- Cluster messages (if applicable)
- Startup banner
- SYSTARTUP_VMS displays

Steps to Follow When a System Does Not Initialize

If a system does not initialize take the following actions:

1. Check the console display.
 - a. If nothing appears on the console display, check the following:
 - ◆ Does the system have power?
 - ◆ Is the system disk on-line without fault lights?
 - b. If you see hardware initialization displays, but do not see the console >>> prompt:
 - ◆ Check the boot switches (LOCAL, REMOTE, ENABLE, DISABLE, and so on).
 - ◆ Try halting the console according to hardware specific instructions.
 - c. If you see the console >>> prompt, proceed to step 2.
 - d. If you do not see the console prompt, place a service call.
20. Check system manager and operator hardcopy site logs to see if any changes have been made to the software since the last reboot.
21. Reboot the system using a conversational boot.
 - a. Capture the error messages (if any) for review using a hardcopy terminal.
 - b. Read the error messages. Hardware errors are preceded by a question mark (?).
 - c. If you suspect hardware problems, call Multivendor Customer Services.
22. If you see the SYSBOOT> prompt, go to step 6.
23. If you do not see the SYSBOOT> prompt, the problem may reside in the system files. Restore the system disk from a backup copy and go to step 3.

24. At the SYSBOOT> prompt:
 - Use the SHOW/SCS command to display system parameter settings.
 - Look for obvious problems with system parameters.
 - Set the system to boot OPA0: and enter CONTINUE.
25. At the DCL prompt:
 - Check the dates on the system startup files.
 - Remember to use specific directory file specifications.
 - If a file has been modified, run differences against the previous version.
 - Make sure all the files are present.
 - Turn on system verification so that each DCL command entered is displayed.
\$ SET VERIFY
 - Execute the site-specific startup command procedure.
 - Watch the program execute, looking for problems.

Using Standalone Backup in an Emergency

Case Study: A Late Night Call

Late in the evening on a rainy night, the phone rings at the Smith home. John Smith is one of several system and network managers for a number of systems. The caller is the night shift operator at the plant. The plant just had a power outage and when power was restored, one system would not boot.

John lives some distance from the plant and would like to avoid a long trip over slick roads. Here are the questions he asks the operator and the operator's answers.

John's Questions	Operator's Answers
What system is giving the problems?	AXPA
Did you see anything on the console when you tried to boot the system?	Yes. I saw the numbers going across the screen.
Did you get the boot prompt?	Yes
Did you see the OpenVMS banner message?	No
Well let's try a conversational boot. Do you know how to do that?	Yes... O.K... now booting conversationally. Nope failed again.
Did you get the SYSBOOT> prompt?	No

While the operator was trying to boot the system, John recalled a conversation he had with a new system manager regarding a system disk being short on space.

John now knows that he has to restore the system disk from a backup copy. However, the latest system disk backup is three weeks old.

1. What is the probable reason this system will not initialize?
2. How can John restore this system without losing any changes to system disk files that may have been made in the past three weeks?
3. Make a list of recommendations to avoid similar problems in the future.

Case Study Solution: A Late Night Call

1. What is the probable reason this system will not initialize?

It is likely that the new system manager accidentally deleted a file needed for system initialization when he was trying to free up some disk space on the system disk.

26. How can John restore this system without losing any changes to system disk files that may have been made in the past three weeks?

Follow these steps to correct the situation:

- a. Boot standalone Backup according to the processor-specific instructions.
 - b. Make a backup copy of the system disk to tape or to a spare disk.
 - c. Restore a previous backup copy of the system disk from tape.
 - d. Boot the system.
 - e. By comparing the files on the system disk to the files in the save set, you determine that SYSBOOT.EXE was deleted.
 - f. Compare the dates of the files on the system disk with the dates on the latest backup save set to determine if any files have been updated since the original backup was made.
 - g. Restore these files using the full Backup utility.
27. Make a list of recommendations to avoid similar problems in the future.

There is basically no way to prevent a privileged user from deleting a required system file. However, some recommendations include:

 - a. Review the list of all persons having access to the system account. Should any user be removed? Have all these people received sufficient training?
 - b. Conduct a training session for all persons having access to the system account.
 - c. Implement a change management policy that requires any such changes to be documented.
 - d. Eliminate unnecessary privileged accounts.

Avoiding System Initialization Problems

Overview

You can avoid almost all the problems mentioned in this module if changes to the system files are handled in a controlled environment. You can improve the dependability of your system by designing and implementing change management procedures.

This section discusses the change management procedures.

Change Management Procedures

Questions to Ask Before You Schedule Changes

If the answers to the following questions are not satisfactory, do not schedule changes.

- Is the change necessary?
- Has the change been properly researched?
- What is the impact of the change?
- Is this the right time to make the change?
- If something unexpected happens, is there time to reverse the change?
- Are personnel available to help if something goes wrong?
- What procedures are available to return the system to its previous state?

Designing a Standard Procedure to Control Changes

The format of the change management procedure can vary from site to site, but should include the following rules:

- Always make a backup copy of all files *before* you make changes.
- When modifying files, save the previous version of the file under another name so you can use it if something goes wrong. Use a standard naming procedure.
- Document and date all file changes in comments included in the file.
- Record changes in the system manager log files and/or the operator shift reports. Proper notification of changes is required.
- Use the “buddy system.” Have someone check you work.
- Test changes to make sure that they were made correctly and perform as expected.

Training and Enforcement

To make sure that the change management procedure rules are followed:

- Document the change management procedures.
- Provide training for all personnel on the change management procedures.
- Check to see that these procedures are followed by all personnel all the time.

Summary

System Initialization Concepts

The OpenVMS operating system is initialized by a series of programs.

Emergency Initialization Procedures

- When a system does not boot, you should reboot the system conversationally.
- Booting the system so that the startup procedure takes commands from the console is one way to research system initialization problems.
- Booting the system minimally runs all programs except the site-specific startup command procedure.
- To make a copy of the system disk, use standalone Backup.
- When the system files are deleted or corrupted, use standalone Backup to restore the system disk from the backup copy.

Resolving System Booting Problems

- The first step in resolving a system booting problem is to eliminate hardware problems.
- Reboot the system using a conversational boot to isolate the problem.
- To resolve problems caused by missing or corrupted system files, restore the backup copy of the system disk using standalone Backup.
- You can resolve problems with the startup procedures at the DCL level.

Avoiding System Initialization Problems

A change management procedure to control changes to the system software prevents errors that cause system downtime.

Chapter Terms

APB.EXE

Primary bootstrap program on an OpenVMS Alpha system.

Conversational boot

Boot procedure that pauses after loading SYSBOOT.EXE, allowing changes to be made to system parameters.

Standalone Backup

A subset of the Backup utility used to save and restore files on a system that is running a reduced operating system.

SYSBOOT.EXE

Secondary bootstrap program on both OpenVMS Alpha and OpenVMS VAX systems.

VMB.EXE

Primary bootstrap program on an OpenVMS VAX system.

Troubleshooting Printing Problems

Module 3

Introduction

Normal users put a heavy demand on computer systems for hardcopy output. Most systems support various types of printers and use a wide variety of formats and print types. Maintaining the printing environment is an important and time-consuming task of the system and network manager.

A print job is handled by several subsystems on its path from initiation to final completion of the task. Understanding the concepts of the queue management system, LAT queues, and printer formatting options enables you to handle and prevent printer problems.

Objectives

To manage printing on OpenVMS systems, you should be able to:

- Describe the concepts of the OpenVMS print queue system.
- Describe the concepts of remote print queues.
- Set up a remote print queue.
- Apply the troubleshooting methodology to print queue problems.
- Describe how OpenVMS formats a print job.

Resources

- *OpenVMS System Manager's Manual*
- *OpenVMS System Management Utilities Reference Manual*

OpenVMS Batch and Print Queue System Concepts

Overview

When a user submits a print job on an OpenVMS system, the job is handled by the OpenVMS batch and print queue system and the print symbiont. The device setting of the printer also influences the print job.

The system and network manager is responsible for setting up and maintaining the print queues and the system printers.

This section discusses:

- OpenVMS batch and print queue system
- Queue manager process
- Job controller process
- Queue database
- Obtaining information on queue system processes
- Print symbiont
- Customizing print queues
- Queue access

OpenVMS Batch and Print Queuing System

Print Queuing Process

The print queuing process follows these steps:

1. A user enters the DCL PRINT command.
2. The following information is sent to the OpenVMS software that manages batch and print queues:
 - Type of job
 - File name or names
 - Queue name
 - Special options
3. The information is stored in a queue database.
4. The print job is placed in the appropriate **queue** to await its turn for processing and the user is notified.
5. Print jobs are sent to an independent process, called a *symbiont* for formatting.
6. The formatted print files are sent to the printer.

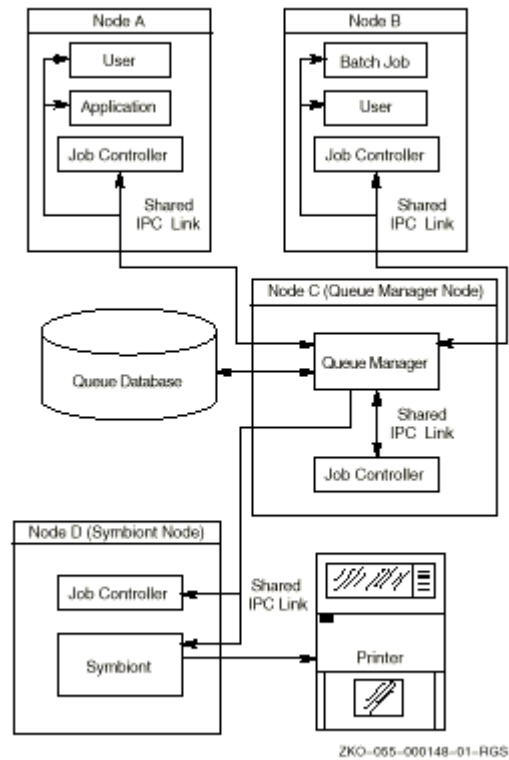
Software Components

The following are the software components of the OpenVMS batch and print queuing system:

- Queue manager processes running on one or more nodes in the cluster
- One or more queue databases
- Job controller process on each node of the cluster
- Print symbiont

Figure: OpenVMS Batch and Print Queuing System

The following figure shows the OpenVMS batch and print queuing system.



Queue Manager Process

Queue Manager Process in an OpenVMS Cluster System

An OpenVMS Cluster system has one or more queue manager processes. The system and network manager can designate a single node to run queue manager processes, or run several queue managers across several cluster nodes.

In this section, the discussion focuses on a cluster with a single queue manager. User processes, symbionts, and job controllers on each node communicate directly with the central queue manager through a shared *interprocess communication (IPC) link*.

Jobs submitted from one node can execute on a queue running on another node in the cluster.

Starting the Queue Manager and Creating the Queue Database

Enter the following command to start the queue manager and create the queue database in SYS\$COMMON:[SYSEXE] on an OpenVMS Cluster system,:

```
$ START/QUEUE/MANAGER/NEW_VERSION/ON=(node-list )
```

where node-list is a list of the nodes in the cluster.

The queue manager starts on the first node in the list. If the node that is running the queue manager fails, the process fails over to the next node in the list.

After you enter the command, the command is stored in the queue database. Thereafter, the job controller process starts the queue manager during reboot unless a STOP/QUEUE/MANAGER/CLUSTER command is entered.

Queue Manager Failover

If the node on which the queue manager process is running leaves the cluster, a system job controller starts the queue manager on another node, based on the priority specified by the system and network manager.

Job Controller Process

In an OpenVMS Cluster system, there is one job controller process on each node.

- The job controller process is started by the startup command procedure.
- The job controller process name is JOB_CONTROL.
- If the job controller process stops, restart it as follows:
\$ @SYS\$SYSTEM:STARTUP JOBCTL

Job Controller Queue Management Functions

Job controller queue management functions are to:

- Create and monitor batch, symbiont, and queue manager processes.
- Start the queue manager.
- Handle the failover of the queue manager to another OpenVMS Cluster node when the node on which the queue manager is running leaves the cluster.

Events That Cause the Job Controller to Perform Queue Functions

The job controller logic that performs these functions runs when one of the following events occurs:

- The job controller process is started.
- The queue manager process terminates.
- A START/QUEUE/MANAGER command is entered.
- The preferred list of nodes on which the queue manager is to run is changed.

Queue Database

Purpose

The queue database stores information used to keep the queuing system operating. This includes information about:

- Jobs
- Queues
- Queue manager

The queue database is stored on disk and is nonvolatile.

Files

The queue database is made up of the following files:

- QMAN\$MASTER.DAT — the master file
- SYS\$QUEUE_MANAGER.QMAN\$QUEUES — the queue file
- SYS\$QUEUE_MANAGER.QMAN\$JOURNAL — the journal file

Queue Master File

The master file is shared by the job controller and queue manager.

The master file contains:

- Pointers to the queue and journal files
- Definitions of forms and characteristics
- List of queue names
- List of nodes allowed to run the queue manager

Queue File

The queue file contains the queue definitions you specify when you create, start, or modify queues using the commands:

- INITIALIZE/QUEUE
- START/QUEUE
- SET QUEUE

Queue Journal File

The journal file contains the following information about jobs in the queues:

- Job definitions
- Updates to the queue and master files
- Information that allows the queue manager to return to the last known state if a system running the queue manager unexpectedly stops or leaves the OpenVMS Cluster system

The queue manager allocates space for the journal file.

- Each job submitted to a queue makes an entry in the journal file.
- When the journal file is filled, the queue manager allocates space for a new journal file.
- Newly created files are entered in the new journal file.
- Entries related to active jobs are transferred from the old journal to the new file.
- When the transfer is complete, the old journal file is deleted.

In-Memory Queue Manager Database

The queue manager maintains a database in memory that contains all the information needed for job processing.

The database in memory is built by:

- Reading all data from the queue file into memory
- Reading the required data from the journal file
- Verifying outstanding queuing system communications and job requests and resubmitting them as needed
- Verifying that all objects such as processes and queues that are referenced in the queue database are valid

Information required to process jobs and information requests is stored in the in-memory database and copied to the journal file to prevent loss of jobs and messages during a queue manager failover.

Default Queue Database Location

The three files that make up the queue database are located by default:

- On the system disk of the node that first creates the queue database
- In the directory SYS\$COMMON:[SYSEXE]

Alternate Location for the Queue Database

When space on the system disk is limited, you can move the queue database to another disk.

- The queue file and the journal file must be located in the same directory.
- In an OpenVMS Cluster environment, the logical name QMAN\$MASTER must be defined identically on all nodes in the cluster.

Performance Considerations

The performance of the queuing system is dependent on the performance of the disk that contains the queue journal file.

To obtain the best performance, place the journal file on:

- A disk dedicated to the queuing system
- A solid-state disk

If the journal file is located on a shared magnetic disk, use as fast a disk as possible.

Moving Queue and Journal Files

To move the queue file and the journal file, perform the following steps:

- Shut down the queue manager by entering the DCL command:
\$ STOP/QUEUE/MANAGER/CLUSTER
- Copy the files to their new location. The queue and journal files must reside in the same directory.
- Remove the original copies of the files.
- Restart the queue manager by entering the following DCL command, where *directory-name* is the directory specification for the directory containing the queue and journal files:

```
$ START/QUEUE/MANAGER]device:[directory-name]
```

In an OpenVMS Cluster environment, if the string substituted for *directory-name* in the command is a concealed logical name, it must be identically defined on all nodes in the cluster.

After you restart the queue manager, the directory location is stored in the master file. If you restart the queue manager a second time, you do not have to specify the directory location of the queue and journal files.

Moving the Master File

To move the master file from the default location, perform the following steps:

1. Shut down the queue manager by entering the DCL command:
`$ STOP/QUEUE/MANAGER/CLUSTER`
2. Copy the file QMAN\$MASTER.DAT to its new location.
3. Edit the file SYS\$COMMON:[SYSMGR]SYLOGICALS.COM to add the following line defining the logical name QMAN\$MASTER, where *directory-name* is the complete directory specification for the directory where the file is located:

```
$ DEFINE/SYSTEM/EXECUTIVE_MODE QMAN$MASTER device:directory-name
```

On an OpenVMS Cluster system, QMAN\$MASTER must be defined identically on all nodes in the cluster.

4. Restart the queue manager by entering the DCL command:
`$ START/QUEUE/MANAGER`

Backup and Restore of the Queue Database

To save a record-by-record copy of the queue database *while the queuing system is functioning*, perform the following steps:

1. Use the Convert utility to save the master file and the queue file with different file names.
`$ CONVERT/SHARE QMAN$MASTER.DAT QMASTER.KEEP`
`$ CONVERT/SHARE SYS$QUEUE_MANAGER.QMAN$QUEUES QFILES.KEEP`
2. Use the OpenVMS Backup utility to save the files created with the Convert utility.
`$ BACKUP/LOG QMASTER.KEEP,QFILE.KEEP saveset-name`

Obtaining Information on Queue System Processes

Displaying Queuing System Processes

Use the SHOW SYSTEM command to look for the four processes used by the queuing subsystem.

```
$ SHOW SYSTEM
```

```
OpenVMS V7.2 on node VRR00M 15-DEC-1998 10:01:33.55 Uptime 30 19:57:02
```

Pid	Process Name	State	Pri	I/O	CPU	Page flts	Pages
00000201	SWAPPER	HIB	16	0	0 00:00:07.57	0	0
00000207	IPCACP	HIB	10	7	0 00:00:00.08	95	183
0000020B	JOB_CONTROL	HIB	10	649	0 00:00:08.61	292	426
0000020C	QUEUE_MANAGER	HIB	8	237	0 00:00:03.60	712	1065

```
.  
.
.
```

Using the Operator Log File

The job controller and queue manager write error information to the operator terminal and operator's log file.

To extract queuing system information, enter the following command:

```
$ SEARCH SYS$MANAGER:OPERATOR.LOG /WINDOW=n QUEUE_MANAGE, JOB_CONTROL -  
- /OUTPUT=file-name
```

Print Symbiont

Function of the Print Symbiont

An output execution queue accepts jobs for processing by a symbiont.

- A symbiont is a process that transfers record-oriented data to or from a device.
- As the symbiont processes each file, it produces output for the device it controls, such as a printer or a terminal.
- The symbiont process is designated when the queue is established.

Standard OpenVMS Print Symbionts

The standard print symbiont provided by the OpenVMS operating system is named PRTSMB.EXE and is designed to print files on hardcopy devices.

Other symbionts include:

- LATSYM.EXE — Prints files on output devices connected to terminal servers
- CPS\$SMB.EXE — Prints files on PostScript printers on the LAT
- LPS\$SMB.EXE — Prints files on LPS printers

System Resources for the Print Symbiont

The print symbiont is an OpenVMS process, and, like all processes, needs system resources.

The job controller creates the print symbiont as a detached process with the same WSDEFAULT, WSQUOTA, and WSEXTENT as the job controller when a START/QUEUE command is executed.

The job controller gets its quota values from the RUN/DETACH command that creates it.

Qualifiers to the INITIALIZE/QUEUE command can modify the resource quotas for the print symbiont. Some examples of resource quotas that can be modified are:

- BASE_PRIORITY
- WSDEFAULT
- WSEXTENT
- WSQUOTA

Displaying the Symbiont Process

Use the SHOW SYSTEM command to display the symbiont processes.

\$ SHOW SYSTEM

OpenVMS V7.2 on node BROWNY 15-DEC-1998 10:09:55.00 Uptime 30 20:05:23

Pid	Process Name	State	Pri	I/O	CPU	Page flts	Pages
00000201	SWAPPER	HIB	16	0 0	00:00:07.64	0	0
00000205	CONFIGURE	HIB	8	5 0	00:00:00.08	114	179
00000207	IPCACP	HIB	10	7 0	00:00:00.08	95	183
00000208	ERRFMT	HIB	8	18775 0	00:01:11.96	151	239
00000209	OPCOM	HIB	9	256258 0	00:16:13.12	912	170
0000020A	AUDIT_SERVER	HIB	10	267 0	00:00:01.43	495	867
0000020B	JOB_CONTROL	HIB	10	649 0	00:00:08.61	292	426
0000020C	QUEUE_MANAGER	HIB	8	237 0	00:00:03.60	712	1065
0000020D	SECURITY_SERVER	HIB	10	361 0	00:00:06.54	1489	1625
00000210	NETACP	HIB	10	122679 1	21:39:59.51	9008	9024
00000211	EVL	HIB	4	328901 0	00:08:10.23	316	593 N
00000212	REMACP	HIB	9	201 0	00:00:00.40	107	87
00000213	LATACP	HIB	14	10 0	04:56:06.01	870	841
00000214	NMAIL	HIB	4	6 0	00:00:00.16	263	96
00000215	INSPECT\$Exec	HIB	8	2655 0	00:00:25.74	10997	393
00000218	SYMBIONT_4	HIB	6	184 0	00:01:34.90	2329	216
00000219	SYMBIONT_5	HIB	6	184 0	00:01:31.87	1848	219
0000021A	SYMBIONT_6	HIB	6	31 0	00:01:30.81	1061	193
0000021B	SYMBIONT_7	HIB	6	31 0	00:01:30.35	1060	193
0000021C	SYMBIONT_8	HIB	6	31 0	00:01:31.80	1059	193

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Customizing Print Queues

Queue Options

You can customize print queues by specifying certain options for each queue when it is defined. Options can:

- Set up the queue to print flag pages at the beginning of each job, or trailer pages at the end of each job, or both.
- Associate a print form with a queue to:
 - Set up the printer for certain formats using device control modules.
 - Associate a paper stock with a queue.
- Restrict access to the queue.
- Control the way jobs flow through queues.
- Control the resources available to the print symbiont process.
- Specify a queue as a generic queue.
- Control which jobs execute on a queue.
- Designate an execution queue as an autostart queue, and control the node on which it will run and the nodes to which it will fail over.

How to Set Options on a Print Queue

You can customize a queue with qualifiers to the following commands:

- INITIALIZE/QUEUE
- START/QUEUE
- SET QUEUE

Queue definitions are stored in the queue database file. Queues do not have to be initialized each time the system is rebooted

Displaying Print Queue Options

To resolve printer problems, you must obtain information about the generic queue, the execution queue, and the jobs in the queue.

```
$ SHOW QUEUE/FULL/ALL SYS$PRINT
```

```
Generic printer queue SYS$PRINT
```

```
  /GENERIC=(LPS40$SCDTST) /OWNER=[1,4] /PROTECTION=(S:E,O:D,G:R,W:W)
```

```
$ SHOW QUEUE/FULL/ALL LPS40$SCDTST
```

```
Printer queue LPS40$SCDTST, busy, on NODE01::SCDTST, mounted form
  DCPS$DEFAULT (stock=DEFAULT)
```

```
  /BASE_PRIORITY=4 /DEFAULT=(FORM=DCPS$DEFAULT (stock=DEFAULT))
```

```
  /NOENABLE_GENERIC /LIBRARY=DCPS_LIB /OWNER=[1,4] /PROCESSOR=DCPS$SMB
```

```
  /PROTECTION=(S:M,O:D,G:R,W:S) /SCHEDULE=(NOSIZE)
```

```
  /SEPARATE=(BURST,FLAG,TRAILER)
```

```
Entry Jobname      Username    Blocks Status
```

```
-----
```

```
691  LOGIN        SMITH       4      Printing
```

```
      Submitted 15-DEC-1998 12:18 LP$$$FORM (stock=DEFAULT)
```

```
      /PRIORITY=100
```

```
      File: _$1$DUA1:[SMITH]LOGIN.COM;25 (printing)
```

Autostart Queues

The autostart feature simplifies queue startup and ensures high availability of execution queues in a cluster.

The autostart feature allows you to do the following:

- Start all autostart queues on a node at system startup with a single command.
- Specify a list of nodes (within an OpenVMS Cluster system environment) to which a queue can automatically attempt to fail over if a node leaves the cluster.

You can design execution print queues as autostart queues.

You cannot designate generic queues as autostart queues.

Initializing Autostart Execution Queues

To initialize an autostart execution queue, use the /AUTOSTART_ON qualifier.

```
$ INITIALIZE/QUEUE/AUTOSTART_ON=(node::device,,,)/START queue-name
```

To notify the queue manager to automatically start all active autostart queues on a node, use the following command in the system startup command procedure:

```
$ ENABLE AUTOSTART
```

Making an Autostart Queue Inactive

To make an autostart queue inactive, use the `STOP/QUEUE` command.

- An inactive autostart queue remains inactive until a `START/QUEUE` command is entered.
- You might want to stop a specific autostart print queue if the printer is being serviced.

Disabling All Autostart Execution Queues

Use the `DISABLE AUTOSTART/QUEUES` command to notify the queue manager process to perform the following tasks on a node that is to be stopped:

- Mark all autostart queues as “stop pending” in preparation for a planned shutdown of the system.
- Prevent autostart queues from failing over to the node.
- Upon completion of any job executing on one of the node's autostart queues, force the queue to fail over to the next available node in a queue's failover list (if any) on which autostart is enabled.
- Autostart queues that do not have a failover list of nodes remain activated for autostart. The queue manager process restarts the stopped autostart queues when the `ENABLE` command is entered.

Queue Access

Restricting Access to a Queue

As with files, you can use UIC-based or ACL-based protection to control access to a queue.

There is a laboratory exercise involving a problem with queue protection.

Types of Queue Access

The following types of queue access are allowed:

Access		Function
W	SUBMIT	Submits jobs to the queue AND manages their jobs.
D	DELETE	Modifies and deletes jobs in a queue.
R	READ	Displays attributes of jobs in a queue.
E	MANAGE	Modifies any nonsecurity attribute of a queue and deletes the queue. Also allows SUBMIT, DELETE, and READ access.

Default Queue Protection

The system applies the default queue protection: (S:E,O:D,G:R,W:W)

- System MANAGE
- Owner DELETE
- Group READ
- World SUBMIT

Displaying Queue Protection

When a user is unable to print a file to a queue, you may want to check the queue protection.

```
$ SHOW SECURITY /CLASS=QUEUE LPS20$CRIER
```

```
LPS20$CRIER object of class QUEUE
```

```
Owner: [SYSTEM]
```

```
Protection: (System: M, Owner: D, Group: R, World: S)
```

Remote Print Queue Concepts

Overview

A remote print queue is associated with a printer connected to a terminal server.

A *terminal server* is a communications server that provides an efficient way to connect terminals, modems, printers, and other devices to the Ethernet local area network (LAN).

To troubleshoot problems on remote print queues, the system manager should be familiar with LAT tools and concepts.

This section discusses:

- LAT network concepts
- Terminal server concepts
- LAT management tools

LAT Network Concepts

Overview

The primary goal of the LAT is to provide users with access to computing resources connected to terminal servers.

Terminal servers use the LAT network *protocol* to communicate on an Ethernet LAN. LAT software and hardware implement the protocol on an OpenVMS system.

A LAT network consists of:

- Service nodes
- Terminal server nodes

Service Nodes

Each OpenVMS node on a LAT network can offer its resources as a *service*.

- Most nodes offer general processing services (interactive login).
- A node can also be set up to offer a special application processing service.

For example, an OpenVMS service node might offer three services:

- General processing
- Data entry application
- Stock quote application

Each service is distinguished by a name assigned by the system manager.

Terminal Server Node

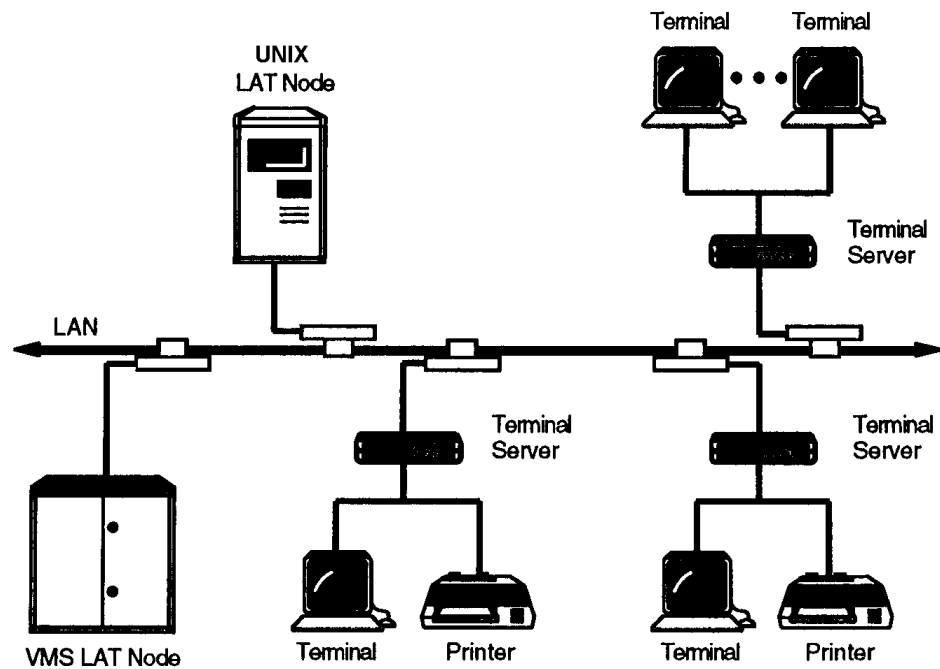
A terminal server is an Ethernet communications device that can establish and manage virtual circuit connections between serial devices and LAT hosts.

All Compaq terminal servers support:

- Terminals
- Printers

Sample LAT Network

The following figure shows a sample LAT network.



ZKO-055-000148-05-RGS

Service Advertisements

An OpenVMS service node advertises its services over the network at regular intervals so that terminal servers know where network resources are available. The service announcement provides:

- Physical node name
- Service names
- Description of services
- Rating

Terminal servers listen to the Ethernet advertisement and record information.

When a user terminal requests service, the terminal server node requests connection to the appropriate OpenVMS service node.

Types of Service Requests

There are two types of service request:

1. User-initiated request (local access)
 - Connection request from the user on a server port to a LAT service.
 - An example is a request from a user to connect to a service node.
2. Host-initiated request (remote access)
 - Connection from a LAT service node to a terminal server.
 - An example is a request from a service node to print a job on a printer attached to a terminal server.

Terminal Server Concepts

A terminal server is a computer with:

- CPU
- Memory
- Operating system
- I/O controllers

Most Compaq terminal servers are nodes without disks.

When the terminal server is started up following a shutdown or power loss, the software image is downline loaded from another node on the network known as the load host.

Devices attach to the server at terminal server *ports*.

Terminal Server Operating Modes

In *local mode*, an interactive user enters server commands to communicate directly with the server.

In *service mode*, an interactive user communicates with a service. The server does not usually interpret data entered by the user.

Terminal Server Differences

Some features of terminal servers are device-specific.

- Operating system used
- Method of storing and loading the operating system
- Database storage and method of update

Refer to the documentation for information about specific devices.

Terminal Server Databases

There are two types of terminal server databases:

1. Permanent database
 - Values set in the permanent database remain constant through initializations, power losses, and port logins.
 - Privileged users can modify server and service characteristics in the permanent database. These changes do not take effect until the server is reinitialized.
 - Privileged users can modify port characteristics. Changes to port characteristics become operational when the user logs out of the port and then logs back in or when the server is reinitialized.
2. Operational or volatile database
 - After initialization, the operational database is a copy of the permanent database.
 - Privileged users can modify some server and service characteristics. Changes take effect immediately and remain in effect until the server is initialized.
 - Both privileged and nonprivileged users can modify some port characteristics in the operational database. Changes take effect immediately and remain in effect until the server is initialized or the port is logged out.

Troubleshooting Terminal Servers

Whenever you have a situation where a device works for a period of time, but does not work after the system is rebooted, investigate the following:

- Does this device use a volatile database?
- Were any definitions made to the volatile database that were not made permanent?

Displaying Server Characteristics

A general user can enter commands in local mode at the terminal server prompt to display the information in the database.

```
Local> SHOW PORT CHARACTERISTICS
```

```
Local> SHOW SERVICE CHARACTERISTICS
```

Testing a Terminal Server Port

To verify that a terminal server port is working correctly, a privileged user can:

- Log in to the server.
- Test the port using the command:

```
Local> TEST PORT # COUNT #
```

The server sends out a rotating character pattern to the port, which is displayed on the terminal.

If the pattern is not displayed or if the display is not consistent, there is something wrong with any of the following:

- Server
- Port
- Terminal
- Cabling out to the terminal

Example: Terminal Server Port Test

The following test indicates that the port is working correctly because the test pattern is consistent.

```
# [password]
```

```
Network Access Sw V1.5 for DS700-16 BL95-33 ROM V3.4-9 Uptime: 35
18:54:58
```

```
Please type HELP if you need assistance
```

```
Enter username> SYSTEM
```

```
Local> TEST PORT COUNT 3
```

```
!"#$%&'()*+,-
./0123456789:;<literal>(<)=?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[^_`abc
!"#$%&'()*+,-
./0123456789:;<literal>(<)=?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[^_`abcd
!"#$%&'()*+,-
./0123456789:;<literal>(<)=?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[^_`abcde
Local>
```

LAT Management Tools

LAT Control Program

The LAT Control Program (LATCP):

- Is bundled with the OpenVMS operating system
- Is used to configure and control the LAT software from a LAT service node

Uses for the LATCP

The LATCP allows you to do the following:

- Start and stop the LAT port driver (LTDRIVER) on an OpenVMS system.
- Specify operational characteristics for your service node and its services.
- Display the status for your LAT service node.
- Show and zero LAT counters.

Invoking the LATCP

To invoke the LATCP, enter the command:

```
$ RUN SYS$SYSTEM: LATCP
```

You can enter LATCP commands at the prompt.

Sample LATCP Commands

The following are some commands that you can enter using the LATCP:

SET NODE/STATE=ON	Starts the LAT port driver on the local node
SET NODE/STATE=OFF	Stops the LAT port driver on the local node
SHOW (entity)	Displays the LAT information specified
SET (entity)	Modifies the LAT information specified

LATCP DCL Command Line Interface

You can define a DCL symbol to execute a single LATCP command in a command procedure.

```
$ LCP ::= $LATCP
```

Within a command procedure, you can enter a single command to the LATCP.

```
$ LCP START NODE
```

Troubleshooting Printer Queue Problems

Overview

There are many variables in managing a printer queue or remote printer queue. To troubleshoot problems with printer queues, it is most important to define and isolate the problem.

Remote print queue problems usually fall into one (or more) of the following categories:

- OpenVMS print queue problems
- LAT symbiont problems
- LAT device-mapping problems
- Hardware problems

This section discusses some printer queue troubleshooting tips.

Troubleshooting Tips

Questions to Ask

Obtain more information about the problem.

- Is this a new remote print queue installation? Has it ever worked?
- How many remote print queues are on this system? Are any queues working?
- If there is another print queue on this terminal, is it working?
- Did anything change immediately before the printer stopped working?
- Is there a queue on another system in the network pointing to this printer? Is it working?
- What error messages do you get when you print to the queue?
- What command was used to issue the print request?
- Is /RETAIN=ERROR set on the queue? If not, set it and try again.

Starting the Investigation

If the problem is with a new remote print queue that has never worked, the problem is most likely to be found in:

- LAT device mapping
- Hardware

If the problem is with an existing queue that has had no recent changes made to it, but just stopped working, start by investigating:

- Device....Is it on?
- OpenVMS queuing system
- LAT symbiont

Of course, if you are aware that a change has been made, start by investigating the change.

Isolating the Point of Failure

Replace the printer with a terminal connected to the printer port.

Can you reach the node that hosts the printer queue?

Using the COPY Command to Test a Printer

A powerful tool to isolate remote printer queue problems is the COPY command. However, if a device is set spooled, even a privileged user cannot use the COPY command to test the printer. To use this tool on a spooled printer:

- Determine the LTA# of the device in question using the command:
`$ SHOW QUEUE/FULL/ALL queue-name`
- Stop the queue using the command:
`$ STOP/QUEUE/RESET queue-name`
- Set the device to NOSPOOL.
`$ SET DEVICE/NOSPOOL LTA####`
- Copy a file to the device. Make sure the file is at least one page long.
`$ COPY/LOG file-name LTA####:`
- Repeat the copy command six or more times.
- If the copy command works, check the print queue or the way the device is spooled.
- If the copy command fails, check:
 - Mapping to the port on the server
 - Cable
 - Printer
- To restore the original condition, use the SET DEVICE command and start the queue that was stopped.

Obtaining Information About the Queue

Check the status of the queue using the SHOW QUEUE/FULL/ALL command. This provides the following information:

- Type of queue: printer, generic, logical
- Queue state
- Job state

```
$ SHOW QUEUE/FULL/ALL LPS20$PRTA
```

```
Printer queue LPS20$PRTA, busy, on NODE01::LTA1, mounted form
DCPS$DEFAULT
```

```
(stock=DEFAULT)
```

```
/BASE_PRIORITY=4 /DEFAULT=(FORM=DCPS$DEFAULT (stock=DEFAULT))
```

```
/NOENABLE_GENERIC /LIBRARY=DCPS_LIB /OWNER=[1,4] /PROCESSOR=DCPS$SMB
```

```
/PROTECTION=(S:M,O:D,G:R,W:S) /SCHEDULE=(NOSIZE)
```

```
/SEPARATE=(BURST,FLAG,
```

```
TRAILER)
```

```
Entry Jobname      Username    Blocks    Status
```

```
-----
```

```
78  LOGIN          SMITH       4          Printing
```

```
Submitted 16-DEC-1998 12:24 /FORM=DCPS$DEFAULT (stock=DEFAULT)
```

```
/PRIORITY=100
```

```
File: _$1$DUA1:[SMITH]LOGIN.COM;25 (printing)
```

```
$
```

Can other nodes print to this printer?

Checking Mapping to the Server Port

Use the LATCP to examine the state of the LAT ports on a node.

\$ MC LATCP

LATCP> SHOW PORT

Port Name	Port Type	Status	Remote Target (Node/Port/Service)
-----	-----	-----	-----
-			
_LTA1:	Application	Inactive	ZK1115/3062A/
_LTA2:	Application	Inactive	ZK1115/3062B/
_LTA101:	Application	Inactive	ZK1123/12D/
_LTA102:	Application	Inactive	ZK1122/12B/
_LTA5016:	Forward	Inactive	//
_LTA5192:	Interactive	Active	//
_LTA5195:	Interactive	Active	//
_LTA5210:	Interactive	Active	//

LATCP> SHOW PORT LTA1

Local Port Name: _LTA1: Local Port Type: Application (Queued)
 Local Port State: Inactive
 Connected Link:
 Target Port Name: 3062A Actual Port Name:
 Target Node Name: ZK1115 Actual Node Name:
 Target Service Name: Actual Service Name:

LATCP>

Getting a Test Sheet from the Printer

Refer to the printer instructions to determine the appropriate printer settings.

Checking the Hardware

Install a terminal at the end of the printer cable and repeat the COPY command.

- If the COPY command fails, replace the cable and try again.
- If the COPY command works, the problem is with the printer.
 - Check the power source.
 - Call the appropriate printer repair service.

Print Job in Pending or Holding State

A print job goes into a Pending or Holding state whenever the job is not eligible to print. Possible causes include:

- The queue is currently printing another job.
- The queue is stopped or stalled.
- The print job was submitted with an /AFTER= time qualifier.
- The print job is waiting for a paper stock to be mounted on the queue.
- The print job was submitted with /CHARACTERISTICS that are not identified with the queue.
- There is a BLOCK_LIMIT on the queue, and the print job does not fall within the specified block range.

Example: Print Job Submitted with /AFTER Qualifier

The following print job was submitted with the /AFTER qualifier to the PRINT command.

```
$ PRINT/QUE=LPS20$PRT1/AFTER=14:30 LOGIN.COM
```

Job LOGIN (queue LPS20\$PRT1, entry 91) holding until 16-DEC-1998 14:30

```
$ SHOW QUEUE/FULL/ALL LPS20$PRT1
```

Printer queue LPS20\$PRT1, idle, on *NODE01::PRT1*, mounted form DCPS\$DEFAULT

```
/BASE_PRIORITY=4 /DEFAULT=(FORM=DCPS$DEFAULT (stock=DEFAULT))
```

```
/NOENABLE_GENERIC /LIBRARY=DCPS_LIB /OWNER=[1,4] /PROCESSOR=DCPS$SMB
```

```
/PROTECTION=(S:M,O:D,G:R,W:S) /SCHEDULE=(NOSIZE) /SEPARATE=(BURST,FLAG,TRAILER)
```

Entry	Jobname	Username	Blocks	Status
-----	-----	-----	-----	-----
91	LOGIN	SMITH	4	Holding until 16-DEC-1998 14:30
	Submitted 16-DEC-1998 14:06 /FORM=DCPS\$DEFAULT (stock=DEFAULT)			
	/PRIORITY=100			
	File: _\$1\$DUA1:[SMITH]LOGIN.COM;25			

```
$ SET ENTRY 91/AFTER=14:05
```

```
$ SHOW ENTRY
```

Entry	Jobname	Username	Blocks	Status
-----	-----	-----	-----	-----
91	LOGIN	SMITH	4	Printing
	On busy printer queue LPS20\$PRT1			

How OpenVMS Formats a Print Job

Overview

Three components contribute to formatting a print job:

- Print symbiont
- Driver
- Printer

You should understand the contribution of each of these components to troubleshoot problems with print job formats.

This section discusses:

- How a print file is formatted
- Troubleshooting file output problems

How a Print File Is Formatted

Print Symbiont

The print symbiont formats the data in a file according to the form assigned:

- To the print queue
- By the DCL command
\$ PRINT/FORM=form_name file-name

Example form:

```
$ DEFINE/FORM/WIDTH=80/WRAP/MARGIN=(TOP=3,BOTTOM=6)/LENGTH=66 DEFAULT 0
```

With the example form, the print symbiont counts lines as they are printed. The symbiont “knows” that it must leave a bottom margin of six blank lines after it prints 60 lines as follows:

- Three for the top margin
- Fifty-seven lines of text

The symbiont inserts a form-feed character (<FF>) into the data stream to position the next page.

Driver Reformats the File

The print symbiont sends the file to the device driver, which reformats the file according to its own settings.

The device driver settings are determined by one of the following DCL commands:

- SET TERMINAL (for terminal printers)
- SET PRINTER (for line printers)

For example, a port is defined:

```
WIDTH=60
/WRAP
```

If the driver receives 80 characters of data from the print symbiont, it inserts a line-feed character (<LF>) after column 60.

The print symbiont sets the page length of the port to that specified on the form.

The device driver also counts the lines as they are printed and looks for the form-feed character (<FF>) in the data stream FF. If it finds an FF, it acts according to the device setting.

Setting	Action
/FORM	The driver passes the FF character to the printer.
/NOFORM	The driver converts the FF character to the number of LF characters needed to get the printer to advance to the top of the next physical page of paper.

Printer

The driver sends the formatted file to the printer.

Printer characteristics supersede those of the symbiont and the driver.

Usually these setup values are for margins and form length. Printer settings are device-specific. They are set by DIP switches on the printer or escape sequences in:

- The file
- A setup module specified in the form

For example, if both the symbiont and the driver format a file with a line 80 characters wide, but the printer is set for 60 characters, the printer only allows 60 characters on the line.

In another example, the printer is set up with a length of 40 lines and a bottom margin of five lines.

- When 35 lines of text are printed, the printer advances five lines to the next page.
- If the paper is 66 lines long, the new page starts on the lower half of the 66-line page instead of advancing to the physical top of the next page, 31 lines away.

Managing Printer Settings

Because the printer settings override those of the symbiont and driver:

- Set the printer length and width to be greater than or equal to the longest and widest setting on your forms.
- Set the port to /NOFORM so the page length is controlled by the print form by having the driver issue multiple LF characters to get to the top of the form.

Troubleshooting File Output Problems

Problem Definition

The output from a print job is not formatted according to the user's requirements.

Find out as closely as possible how the user wants the file to be formatted.

Getting More Information

Get more information by:

- Determining the command that was used to print the file
- Displaying the default form for the queue
- Displaying the form that was specified in the print command (if any)
- Determining the device characteristics

Summary

OpenVMS Batch and Print Queue System Concepts

- The job controller and queue manager processes play important roles in the OpenVMS batch and print queue system.
- The queue database provides nonvolatile storage for queue definitions and forms.
- A print symbiont processes print jobs.
- The system and network manager customizes print queues.
- Use print forms to customize print queues and to set options for print jobs.
- Device control modules are associated with print forms.
- The system manager can control access to queues using UIC and ACL protection.

Remote Print Queue Concepts

- Terminal servers use the LAT network protocol to communicate on an Ethernet network.
- A terminal server is a communications device used to connect terminals and printers to the network.
- Use the LAT Control Program (LATCP) to configure and control the LAT software.

Troubleshooting Print Queue Problems

Isolate the problem to the:

- Print queue system
- Symbiont
- LAT network
- Hardware

How OpenVMS Formats a Print Job

- Three components contribute to the formatting of a print job:
 - Print symbiont
 - Device driver
 - Printer
- To troubleshoot print format problems, obtain a clear definition of the problem.

Chapter Terms

local mode

A user communicating with terminal server software directly is using local mode.

port

A hardware connector on the terminal server where a device plugs in, and the software associated with it (port characteristics).

protocol

A set of rules for communicating.

queue

A sequence of jobs to be processed, for example, a batch job queue or a printer job queue. Processing occurs primarily in first-in/first-out (FIFO) order, but does not reflect the priority of the process that submitted the job.

service

A software application (interactive login, MAIL, PHONE) or hardware device (printer, dial-in lines) available on the network.

service mode

A user communicating with an available service through a terminal connected to a terminal server is using service mode.

service node

A computer system on the Ethernet LAN that offers service.

symbiont

A process that transfers record-oriented data to or from a device. For example, an input symbiont transfers data from card readers to disks. An output symbiont transfers data from disks to line printers.

terminal server

A type of communications server that connects terminals and other devices to the Ethernet LAN.

Troubleshooting OpenVMS Cluster Systems

Module 4

Introduction

An OpenVMS Cluster system is a highly integrated organization of OpenVMS VAX and Alpha computers that share processing resources, data storage, and queues under a single OpenVMS security and management domain. OpenVMS Cluster systems are used to improve system availability.

This module discusses special tools and techniques used to perform troubleshooting in an OpenVMS Cluster system environment.

Objectives

To troubleshoot in an OpenVMS Cluster system environment, you should be able to:

- Describe OpenVMS Cluster system concepts.
- Apply the troubleshooting methodology to solve problems when an OpenVMS Cluster system node will not initialize or join the cluster system.
- Apply the troubleshooting methodology to solve problems when an OpenVMS Cluster system hangs.

Resources

- *Guidelines for OpenVMS Cluster Configurations*
- *OpenVMS Cluster Systems*
- *OpenVMS System Management Utilities Reference Manual*
- *OpenVMS System Manager's Manual*
- *DECnet-Plus for OpenVMS Introduction and User's Guide*
- *DECnet-Plus for OpenVMS Network Management*
- *OpenVMS System Dump Analyzer Utility Manual*

OpenVMS Cluster System Concepts

Overview

To troubleshoot OpenVMS Cluster system problems, you should be able to describe the diagnostic messages produced during both cluster initialization and normal operations. There are some special tools used to troubleshoot problems in OpenVMS Cluster systems.

This section discusses:

- OpenVMS Cluster system software components
- Types of OpenVMS Cluster system nodes
- Cluster communication
- Cluster formation
- OpenVMS Cluster system diagnostic messages
- Using NCP in an OpenVMS Cluster system
- OpenVMS Cluster system bugchecks

OpenVMS Cluster System Software Components

The software components responsible for the OpenVMS Cluster system include the following:

Component	Description
System communications services (SCS)	Implements intercomputer communication according to the Compaq systems communications architecture (SCA)
Connection manager	Uses SCS to maintain the integrity of the cluster by coordinating participation of cluster members; prevents cluster partitioning through the use of quorum
Distributed lock manager	Synchronizes access to resources
Distributed job controller and the queue manager	Make batch and print queues available across the cluster
VAXport drivers	Control the communication paths between local and remote ports. Examples include: PADRIVER for the CI PEDRIVER for the LAN PIDRIVER for the DSSI PEDRIVER for the FDDI XXDRIVER for the Memory Channel
Distributed file system	Allows all computers to share mass storage devices and works with VMS Record Management Services (VMS RMS) to provide file sharing to the record level across the cluster
MSCP server	Makes locally connected disks available to all nodes on the cluster
TMSCP server	Makes locally connected tape drives available to all nodes on the cluster

Types of OpenVMS Cluster System Nodes

Satellite Node

A satellite node does not have a system disk of its own. The OpenVMS operating system is downline loaded to the satellite from a boot server over a network.

Boot Node

Boot nodes are able to downline load the OpenVMS operating system.

A local disk on the boot node contains the cluster startup and authorization and the directory roots from which satellite nodes are booted. This disk can be the boot node's system disk or another local disk on the boot node.

The MSCP server is always loaded on a boot node.

Participating Node

A node can boot from its own system disk, but also participate in cluster activity. In a mixed architecture cluster, for example, there are separate boot servers for OpenVMS VAX and Alpha systems.

Cluster Communication

Overview

There can be many clusters on a given network. The connection manager uses two key pieces of information to determine which systems should be part of any given cluster:

- Cluster group number
- Cluster password

Cluster Group Number

You establish the cluster group number with the CLUSTER_CONFIG utility or the SYSMAN utility. It can be any number between 1 and 4095 or 61440 to 65535. Each cluster on the local network must have a different group number.

You can display the group number from the SYSMAN utility:

```
SYSMAN> CONFIG SHOW CLUSTER_AUTHORIZATION  
Node BROWNY: Cluster group number: 65084  
Multicast address: AB-00-04-01-3C-FF
```

Cluster Password

You establish the cluster password using the CLUSTER_CONFIG utility or the SYSMAN utility. You cannot display the cluster password.

Cluster Formation

Overview

Cluster formation involves a series of interconnected steps as outlined below. In this discussion, a mixed interconnect cluster is assumed. A boot server connects to satellite nodes over an Ethernet.

- 1. Check VAXCLUSTER parameter.**

When an OpenVMS system is booted, it checks the value of the system parameter VAXCLUSTER to determine whether to join or form a cluster.

- 2. Boot server sends HELLO packets.**

In a mixed interconnect cluster, the boot server broadcasts a message over the local network that is addressed to all systems sharing the same cluster group number. The message indicates that the sender is available to downline load an operating system.

The message is made up of the multicast address AA-00-04-01-xx-xx, where xx-xx is the cluster group number plus one.

- 3. Satellite requests boot assistance.**

A satellite that is booting recognizes the HELLO message as coming from a member of its group, and sends a request to the local network for boot assistance. All systems on the network that have boot service enabled check their databases to see if they are configured to boot the satellite.

- 4. Boot server establishes connection.**

All boot servers configured to boot the satellite send a verification message to the satellite, indicating that boot service is available. The satellite acknowledges the first such message received, and ignores all others.

- 5. Boot server sends secondary bootstrap.**

Upon receipt of the acknowledgement from the satellite, the boot server begins to send portions of the secondary bootstrap image. Each portion is acknowledged by the satellite and loaded into its memory. After the final packet has been sent, the boot server sends the address to which the satellite should jump to execute the secondary bootstrap program.

6. Satellite loads operating system

The secondary bootstrap program, through NISCS_LOAD, sends a request for service that contains the cluster group number and password, as well as the device name of the system disk. A connection is made to any MSCP server that shares the group number and password, and is serving the specified disk.

The satellite loads SYSBOOT through the MSCP server and transfers control to it. The boot process then continues much as it would if the system were booting standalone.

OpenVMS Cluster System Diagnostic Messages

Software Sources of Diagnostic Messages

Several types of diagnostic messages are displayed by an OpenVMS Cluster system, including:

- Connection manager messages
- VAXport error messages
- Error log entries for cluster-available devices
- HSC error messages and fault codes

Connection Manager Messages

Connection manager (%CNXMAN) messages:

- Provide information about OpenVMS Cluster system transitions
- Are displayed at the console terminal
- Are generated by events such as:
 - When a node joins or leaves the cluster
 - When the state of the cluster changes

Sample Connection Manager Messages

The following are some examples of connection manager messages:

```
%CNXMAN, Lost connection to system NODEB
%CNXMAN, Waiting to form or join OpenVMS Cluster
%CNXMAN, Sending OpenVMS Cluster membership request to system NODEB
%CNXMAN, Completing OpenVMS Cluster state transition
```

Some additional connection manager messages:

```
%CNXMAN, Now a NODEcluster member -- system NODEA
%CNXMAN, Established "connection" to quorum disk
%CNXMAN, Proposing modification of quorum or quorum disk membership
%CNXMAN, Quorum lost, blocking activity
%CNXMAN, Error reading quorum disk
%CNXMAN, Lost "connection" to quorum disk
%CNXMAN, Proposing modification of quorum or quorum disk membership
%CNXMAN, Timed-out lost connection to system NODEB
%CNXMAN, Aborting VAXcluster state transition
%CNXMAN, Proposing reconfiguration of the VAXcluster
%CNXMAN, Removed from VAXcluster system NODEB
%CNXMAN, Completing VAXcluster state transition
%CNXMAN, Discovered system NODEB
%CNXMAN, Established connection to system NODEB
```

Even though the official name is OpenVMS Cluster, the messages still say VAXcluster.

VAXport Error Messages

Messages from the...	Are prefixed by...
CI port	%PA
Ethernet port	%PE
DSSI port	%PI
FDDI port	%PE
Memory Channel	%xx
SCSI port	%PK

Messages appear in the error log and at the console.

- Use DECEvent software or the SHOW ERROR command to see errors.
- Use DIAGNOSE (OpenVMS Alpha) or ANALYZE/ERROR_LOG (OpenVMS VAX) to examine the error log.

Port Polling

The CI port driver (PADRIVER) performs configuration polling to find other active ports.

- Normally polling occurs every 5 seconds (controlled by system parameter PAPOLLINT).
- It probes cable A, cable B, cable A, and so on.
- It sends and receives REQID packets.
- A handshake starts when packets have exchanged successfully.
- Port drivers then exchange datagrams about the systems.
- If successful, a virtual circuit is opened.

Ethernet Communications

- Every 3 seconds, the port emulator driver (PEDRIVER) sends HELLO messages to an address derived from the group number.
- Nodes send the HELLO back.
- When the driver receives a HELLO from a node that does not currently have an open circuit, it attempts to create one.
- A standard three-message handshake creates the virtual circuit.

System Communications Services (SCS)

- SCS handles communications for
 - Disk class driver
 - Connection manager
 - MSCP server
- SCS is implemented in the VAXport driver.
- As system services discover each other on the system, SCS connections are established.

Example: VAXport Error Messages

The following are examples of VAXport error messages:

```
%PAA0, Software is Closing Virtual Circuit - REMOTE PORT 4
%PAA0, Software is Closing Virtual Circuit - REMOTE PORT 2
%PAA0, Path #1. Loopback has gone from GOOD to BAD
%PAA0, Path #0. Loopback has gone from GOOD to BAD
%PAA0, Path #0. Loopback has gone from BAD to GOOD
%PAA0, Software is Closing Virtual Circuit - REMOTE PORT 3
```

Error Log Entries for Cluster-Available Devices

Many devices, like port drivers, generate errors.

- Errors for nonshared hardware (memory) are logged to the error log file associated with that CPU.
- Errors for shared devices, such as disks or tapes, are directed to only one system.
- Error log entries for HSC or DSSI device errors are:
 - Logged by the system that requested the associated I/O operation
 - Logged as a port error if not associated with I/O operation (HSC ERROR LOGGING DATAGRAM)
- Error log entries for MSCP- or TMSCP-served device errors are:
 - Logged by the system on which the device is local
 - If dual-ported, logged by the system that served the associated I/O operation

HSC Diagnostic Messages and Fault Codes

Diagnostic messages appear at the HSC console terminal.

- If the FAULT light is on, push and release the FAULT switch: The lights will display a pattern indicating a certain fault. Record this pattern.
- If the fault is TU58 drive FAILURE — HSC50 — or MISSING REQUIRED FILES:
 - Make sure the HSC operating system tape is in TU58 drive 0.
 - Try the backup HSC operating system tape.
- For other faults:
 - Power down and reboot the HSC unit.
 - Call your Multivendor Customer Services representative.

If your HSC disks are dual ported, an HSC unit can fail without affecting the rest of the cluster.

- Disks automatically fail over if they are not mounted /FOREIGN, so you may not notice that one of the HSC units has failed.
- Diagnostics are especially important. Look at the indicator lights and console printout regularly.

Using NCP in an OpenVMS Cluster System

The Network Control Program (NCP) displays information about:

- Nodes
- Circuits
- Lines
- The network

NCP SHOW Commands

The following table summarizes common NCP SHOW commands.

This command...	Displays information about...
SHOW NODE node-name CHARACTERISTICS	A single node
SHOW KNOWN CIRCUIT CHARACTERISTICS	All currently defined DECnet circuits
SHOW KNOWN LINE CHARACTERISTICS	All currently defined DECnet lines
SHOW EXECUTOR CHARACTERISTICS	The current system

Example: Displaying Node Characteristics

The following example uses NCP to display the characteristics of a node.

```
NCP> SHOW NODE DBLDOG CHAR
```

```
Node Volatile Characteristics as of 15-DEC-1998 14:40:16
```

```
Remote node = 62.642 (DBLDOG)
```

```

❶Hardware address      = 08-00-2B-30-A0-D2
Tertiary loader        = SYS$SYSTEM:TERTIARY_VMB.EXE
Load Assist Agent      = SYS$SHARE:NISCS_LAA.EXE
Load Assist Parameter  = SYS$SYSDEVICE:<SYS1E.>
```

Example Note: Displaying Node Characteristics

- ❶ These parameters, defined in the DECnet database, allow BROWNY to initiate the cluster system boot process for the node DBLDOG.

Example: Displaying Circuit Characteristics

The following example uses NCP to display circuit characteristics.

```
VRROOM> MC NCP SHOW KNOWN CIRCUITS CHAR
```

```
Known Circuit Volatile Characteristics as of 15-DEC-1998
14:42:41
```

```
❶ Circuit = ISA-0
❷ State           = on
❸ Service         = enabled
  Designated router      = 62.1022
  Cost                   = 4
  Maximum routers allowed= 33
  Router priority       = 64
  Hello timer           = 15
  Type                  = Ethernet
  Adjacent node         = 62.1022
  Listen timer          = 45
```

Example Notes: Displaying Circuit Characteristics

- ❶ The Circuit field displays the name of the circuit as defined in the DECnet database.
- ❷ The State field is on. This circuit is available to process network traffic.
- ❸ The Service field must be set to enabled on the boot node for downline loading to function correctly.

Example: Displaying Line Characteristics

Use NCP to display line characteristics.

```
VRROOM> MC NCP SHOW KNOWN LINES CHAR
```

```
Known Line Volatile Characteristics as of 15-DEC-1998
14:44:10
```

```
Line = ISA-0
Receive buffers      = 10
Controller           = normal
Protocol             = Ethernet
Service timer        = 4000
Hardware address     = 08-00-2B-2F-F2-B3
Device buffer size   = 1498
```

Example: Displaying Executor Characteristics

Use NCP to display information about the DECnet executive.

```
$ MCR NCP SHOW EXECUTOR CHAR
```

Node Volatile Characteristics as of 15-DEC-1998 14:44:58

Executor node = 62.905 (VRR00M)

Identification = DECnet for OpenVMS VAX V7.0

Management version = V4.0.0

Incoming timer = 45

Outgoing timer = 60

Incoming Proxy = Enabled

Outgoing Proxy = Enabled

NSP version = V4.1.0

Maximum links = 32

Delay factor = 80

Delay weight = 5

Inactivity timer = 60

Retransmit factor = 10

Routing version = V2.0.0

Type = nonrouting IV

Routing timer = 600

Broadcast routing timer = 180

Maximum address = 1023

Maximum circuits = 16

Maximum cost = 1022

Maximum hops = 30

Maximum visits = 63

Maximum area = 63

Max broadcast nonrouters = 64

Max broadcast routers = 32

Maximum path splits = 1

Area maximum cost = 1022

Area maximum hops = 30

Maximum buffers = 100

Buffer size = 576

Default access = incoming and outgoing

Pipeline quota = 4032

Alias maximum links = 32
Path split policy = Normal
Maximum Declared Objects = 31

OpenVMS Cluster System Bugchecks

The OpenVMS operating system performs bugcheck operations when it detects conditions that could compromise the integrity of system activity or endanger data integrity.

CLUEXIT Bugchecks

CLUEXIT bugchecks initiated by the connection manager are triggered by conditions resulting from:

- Configuration errors
- System management errors
- Hardware failures
- Operating system failures

Common CLUEXIT Bugcheck Conditions

Some of the most common conditions that result in CLUEXIT bugchecks include:

- Cluster connection between nodes is broken for a longer interval than RECNXINTERVAL seconds.
- The partitioning of the cluster.
- The value of system parameter SCSMAXMSG for a node is too small.

Failure of Nodes to Boot or Join the Cluster

Overview

To perform diagnostic and recovery procedures effectively, you should understand the events that occur when a cluster node boots and attempts to join the cluster.

This section discusses:

- OpenVMS Cluster system initialization concepts
- CI node boot problems
- Satellite node initialization problems

OpenVMS Cluster System Initialization Concepts

Normal Cluster Node Initialization

The normal sequence of events when a cluster CI node or satellite node boots is as follows:

1. The node boots.
2. The node attempts to form or join the cluster.
3. After the booting computer joins the cluster, normal startup procedures execute.

Node Boots

When a node boots:

- A satellite node displays a message that identifies the boot node.
- Both CI nodes and satellite nodes display the OpenVMS banner.
- If the computer is a satellite node, a message like the following shows the name and LAN address of the MOP server that has downline loaded the satellite.

```
%OpenVMS Cluster-I-SYSLOAD, system loaded from Node x... (xx-xx-xx-xx-xx-xx)
```
- At this point, the satellite has completed communication with the MOP server and further communication continues with the system disk server using OpenVMS Cluster system communications.
- For any booting computer, the OpenVMS “banner message” is displayed.

Node Attempts to Form or Join Cluster

When a node attempts to form or join a cluster, the connection manager displays messages such as the following:

waiting to form or join an OpenVMS Cluster system

- If the computer is a member of a local area or mixed interconnect cluster, the cluster security database is loaded.
- Optionally, the MSCP and TMSCP servers are loaded.

If the node finds a cluster, the node attempts to join. The connection manager displays messages such as the following:

%CNXMAN, Sending OpenVMS Cluster membership request to system.

If no cluster is found, the connection manager forms a cluster when enough nodes have booted to establish a quorum. The connection manager displays messages such as the following:

%CNXMAN, Discovered system X...

%CNXMAN, Deleting CSB for system X...

%CNXMAN, Established "connection" to quorum disk

%CNXMAN, Have connection to system X...

%CNXMAN, Have "connection" to quorum disk

Node Joins Cluster

As the booting computer joins the cluster, the connection manager displays a message such as the following:

%CNXMAN, now an OpenVMS Cluster member -- system name

CI Node Boot Problems

Cluster-Related System Initialization Problems

If a CI node initialization fails to achieve the OpenVMS banner:

1. Check to see that the boot startup command procedure specifies:
 - a. The contents of register 0 (R0) to be 20 (indicates booting from CI cable).
 - b. R1 should be the internal bus computer number (if applicable) Multivendor Customer Services supplies this number.
 - c. R2 should be the port number on the Star coupler where the HSC is located, or the HSC node number.
 - d. R3 should contain a hexadecimal value, which is the HSC disk unit number from which the node is to boot.
 - e. R5 should contain the correct root number.
2. Use the HSC SHOW ALL command to check the status of the HSC unit.
 - a. Is it on line and operational?
 - b. Verify that all expected equipment is present and available.
 - c. If the node appears in the display as DISABLED, use the SETSHO utility to set the node to the ENABLED state.

CI Node Fails to Join the Cluster

If the OpenVMS banner is displayed, but the node fails to join the cluster:

1. Check that OpenVMS Cluster system software has been loaded.
2. Check that the system parameter OpenVMS Cluster is 2.
3. Check for the existence of the cluster security database file, `SYS$COMMON:[SYSEXEC]CLUSTER_AUTHORIZE.DAT`.

If all nodes do not use the same security database, the contents of all copies of the database must be the same.
4. Check that the node booted from the correct disk and system root.
5. Check that SCSNODE and SCSSYSTEMID are unique.
6. Check voting or quorum issues.

Satellite Node Initialization Problems

Satellite Initialization Landmarks

When initializing a satellite, look for a load host message in addition to the other initialization landmarks, such as:

- Hardware diagnostics
- Boot prompt >>> (unless autostart)
- Load from host message
- OpenVMS banner
- Startup banner
- SYSTARTUP display

Message from Load Host Not Displayed

If a satellite node fails to display the load host message or banner, check the following:

- Is the DECnet software on the host up and running? Enter the SHOW NETWORK command to check.
- Is the Ethernet boot request being sent and received?
- Is circuit service on the host enabled?
- Is the Ethernet hardware address on the host correct?
- Is the boot device available to the host?

Is DECnet Software Running?

Check to make sure that the DECnet software is running on the load host by entering the DCL command SHOW NETWORK.

If you receive a message similar to the following on the host in response, the network software is running.

```
$ SHOW NETWORK
```

```
Product: DECNET      Node: VMSAFF      Address(es): 61.104
```

If the network is not running, you must start the network before you can initialize the satellite.

Enabling Event Logging

If a satellite node fails to boot, log in as SYSTEM on the boot server and enter the following NCP commands to enable event logging:

```
NCP> SET LOGGING MONITOR EVENT 0.*
```

```
NCP> SET LOGGING MONITOR STATE ON
```

Is the Ethernet Boot Request Received and Sent?

To check that Ethernet boot requests are received and sent:

1. Enter the following DCL command:

```
$ REPLY/ENABLE=NETWORK
```
2. Reboot the satellite node and look at the messages.
 - a. If you get an appropriate MOP service request message similar to the following example, DECnet is not the problem.

```
DECnet event 0.3, automatic line service
From node 3.1 (WHYNOT), 15-DEC-1998 10:34:24.01
Circuit SVA-0, Load, Requested, Node = 3.12 (BECAUS)
File = SYS$SYSDEVICE:<SYS10.>, Operating system
Ethernet address = 08-00-2B-17-AC-04
```

- b. A message similar to the following indicates that the Ethernet address for the satellite node was entered incorrectly or not at all.

```
DECnet event 0.7, aborted service request
From node 3.1 (WHYNOT), 15-DEC-1998 11:07:21.18 Circuit SVA-0,
Line open error,
Ethernet address = 08-00-2B-12-AC-04
```

Verify the load host network database.

- c. If no messages appear, there may be problems with physical cable connections or adapter service, or the satellite node is not generating boot requests.

Verifying the Satellite Information in the Load Host DECnet Database

On the load host, enter the following command to display the satellite node's hardware address:

```
NCP> SHOW NODE satellite-name CHARACTERISTICS
```

If the satellite data is not present in the DECnet database:

1. Examine SYSS\$MANAGER:NETNODE_UPDATE.COM for the satellite nodes data.

If found, execute this procedure.

2. Run CLUSTER_CONFIG and add the satellite node again.

If the data is in the DECnet database, compare the address displayed with the hardware address of the satellite node. To obtain this information, follow the specific instructions for the satellite hardware.

If the Ethernet address is not correct in the load host database, correct it using the CLUSTER_CONFIG procedure.

Verifying the Circuit Service on the Load Host

Use the NCP SHOW CIRCUIT command to verify that the circuit service is enabled on the load host.

```
NCP> SHOW CIRCUIT CHARACTERISTICS circuit-id
```

To enable circuit service:

```
NCP> SET CIRCUIT circuit-id STATE OFF
```

```
NCP> DEFINE CIRCUIT circuit-id SERVICE ENABLED
```

```
NCP> SET CIRCUIT circuit-id SERVICE ENABLED STATE ON
```

Handling OpenVMS Cluster System Hangs

Overview

Certain conditions can cause an OpenVMS Cluster system to hang.

- Cluster quorum is lost.
- A shared cluster resource is inaccessible.

You must be able to identify an OpenVMS Cluster system hang and to take action to restore the cluster.

This section discusses recognizing and handling OpenVMS Cluster system hangs.

Recognizing and Handling OpenVMS Cluster System Hangs

Be Sure the OpenVMS Cluster System Is Hung

Heavy network traffic or a long cluster transition can make the OpenVMS Cluster system appear stopped.

Be patient; the cluster may not be hung at all.

Cluster Quorum Is Lost

When cluster quorum is lost because a voting member exited:

- Process creation and I/O activity on all nodes ceases.
- Information about events that cause loss of quorum is sent to OPCOM and the console terminal at each node.
 - Quorum may be lost before OPCOM has a chance to display the message.
 - OPA0 is the most reliable source of information.

Handling Loss of Quorum

There are two options for restoring cluster quorum.

- Lower quorum and reconfigure the cluster.
- Be sure you know why you are lowering quorum, if you choose to do so, and make sure that you do not set up a situation where the cluster can become partitioned.
- Have a node rejoin the cluster.

Shared Resource Inaccessible

When a process is granted a lock on a resource, other processes must wait to access it.

If the lock is held for an extended period of time, the cluster will appear to hang.

Conditions That Cause Shared Resource Problems

The following conditions can cause the cluster to appear to hang because of shared resource problems:

- Volume rebuilding causes the volume being rebuilt to be locked.
- Locks on parts of SYS\$SYSTEM:SYSUAF.DAT for write access will cause processes attempting to log in to appear to hang.
 - Typically, locks such as this do not endure long enough to cause major problems.
 - If the process with the lock is unable to proceed, the backlog of blocked processes could proliferate rapidly.
 - The lock manager is functioning correctly in this case, so no error messages are generated.

Case Studies

Overview

This section contains two case studies that supplement the laboratory exercises. The case studies do not require you to use the laboratory systems.

The case studies are:

- OpenVMS Cluster system booting problem
- OpenVMS Cluster system communication problem

Case Study Problem: OpenVMS Cluster System Booting Problem

Problem Statement

You are the system manager of an OpenVMS Cluster system consisting of two CI nodes (NODEA and NODEB), one satellite node (NODEC), and one HSC controller. After a power failure, serious problems occur when you try to reboot the cluster.

You begin to investigate the problem by gathering information from the individual systems.

Example: Console Errors

When you boot NODEA, the following errors are displayed on the console:

```
%MSCPLOAD-E-SERVE_ERR, error serving device $4$DUA6: (HSC001), R0  
status = 00000084
```

```
%MSCPLOAD-E-SERVE_ERR, error serving device $4$MUA1: (HSC001), R0  
status = 00000084
```

Example: SHOW CLUSTER /CONTINUOUS Output

The SHOW CLUSTER/CONTINUOUS command produces the following output on NODEA:

```
$ SHOW CLUSTER/CONTINUOUS
```

```
View of Cluster from system ID 123456 node: NODEA 15-DEC-1998 12:59:48
```

```
+-----+-----+
|  SYSTEMS      | MEMBERS |
+-----+-----+
|  NODE | SOFTWARE | STATUS |
+-----+-----+
| NODEA | VMS V7.2 |        |
| JUST  | HSC V400 |        |
| LEGAL  | HSC V400 |        |
+-----+-----+
```

Example: SHOW SYSTEM Output

The SHOW SYSTEM command produces the following output on NODEA:

```
$ SHOW SYSTEM
```

```
OpenVMS V7.0 on node DBLDOG 15-DEC-1998 13:08:26.15 Uptime 34 23:03:54
```

Pid	Process Name	State	Pri	I/O	CPU	Page flts	Pages
00000201	SWAPPER	HIB	16	0 0	00:00:08.99	0	0
00000205	CONFIGURE	HIB	8	5 0	00:00:00.08	114	179
00000207	IPCACP	HIB	10	7 0	00:00:00.08	95	183
00000208	ERRFMT	HIB	8	21283 0	00:01:21.38	151	239
00000209	OPCOM	HIB	8	259856 0	00:16:25.40	925	183
0000020A	AUDIT_SERVER	HIB	10	284 0	00:00:01.50	495	867
0000020B	JOB_CONTROL	HIB	10	752 0	00:00:09.73	293	427
00000210	NETACP	HIB	10	125553 1	22:13:38.64	9008	9024
00000211	EVL	HIB	6	332255 0	00:08:15.22	316	593 N
00000212	REMACP	HIB	8	270 0	00:00:00.49	107	87
00000B47	SYSTEM	CUR	4	1969 0	00:00:42.75	12753	343

Example: Satellite Boot Errors

When you boot the satellite, NODEC, this error is displayed:

2..

?54 Retry

At the same time, on NODEA, an error similar to the following is displayed at the console:

```
%%%%%%%%% OPCOM 15-DEC-1998 09:48:33.3 %%%%%%%%%%
```

```
Message from user DECNET on NODEA
```

```
DECnet event 0-.7, aborted service request
```

```
From node 1.9 (NODEA), 15-DEC-1998 09:48:33.3
```

```
Circuit BNA-0, Line open error, File open error, Load file
```

```
%LAA-F-LCLNOTCLS, local node is not a VAXcluster member
```

```
Node = 1.15 (NODEC), Ethernet address = 08-00-2B-15-23-A9
```

Example: SHOW CLUSTER /CONTINUOUS Output

After booting NODEB, compare the display from SHOW CLUSTER/CONTINUOUS on NODEB to that on NODEA.

```
$ SHOW CLUSTER/CONTINUOUS
```

```
View of Cluster from system ID 123457 node: NODEB 15-DEC-1998 09:52:26
```

```
+-----+-----+
|  SYSTEMS          | MEMBERS |
+-----+-----+
|  NODE | SOFTWARE | STATUS |
+-----+-----+
| NODEB | VMS V7.0 | MEMBER |
| JUST  | HSC V400 |        |
| NODEA | VMS V7.0 |        |
| LEGAL | HSC V400 |        |
+-----+-----+
```

```
$ SHOW CLUSTER/CONTINUOUS
```

```
View of Cluster from system ID 123456 node: NODEA 15-DEC-1998 09:53:40
```

```
+-----+-----+
|  SYSTEMS          | MEMBERS |
+-----+-----+
|  NODE | SOFTWARE | STATUS |
+-----+-----+
| NODEA | VMS V7.0 |        |
| JUST  | HSC V400 |        |
| LEGAL | HSC V400 |        |
+-----+-----+
```

Example: SHOW SYSTEM Output

Issue the SHOW SYSTEM command on both NODEB and NODEA. Compare the displays on each node.

SHOW SYSTEM on NODEB:

\$ SHOW SYSTEM

OpenVMS V7.2 on node NODEB 15-DEC-1998 14:01:02.03 Uptime 0 00:02:45

Pid	Process Name	State	Pri	I/O	CPU	Page flts	Ph.Mem
22600301	SWAPPER	HIB	16	0 0	00:00:00.30	0	0
22600306	CONFIGURE	HIB	10	23 0	00:00:00.12	112	195
22600307	IPCACP	HIB	10	7 0	00:00:00.08	102	169
22600309	ERRFMT	HIB	8	16 0	00:00:00.12	84	144
2260030A	CACHE_SERVER	HIB	16	6 0	00:00:00.05	63	118
2260030B	CLUSTER_SERVER	HIB	10	10 0	00:00:00.11	127	284
2260030C	OPCOM	HIB	8	39 0	00:00:00.26	185	223
2260030D	AUDIT_SERVER	HIB	10	33 0	00:00:00.42	1347	430
2260030E	JOB_CONTROL	HIB	10	35 0	00:00:00.17	152	279
2260030F	SMISERVER	HIB	9	32 0	00:00:00.34	280	510
22600311	NETACP	HIB	10	39 0	00:00:00.40	185	399
22600312	EVL	HIB	5	54 0	00:00:00.33	278	63 N
22600313	REMACP	HIB	9	8 0	00:00:00.06	65	58
22600315	SYSTEM	CUR	14	228 0	00:00:02.91	898	319

SHOW SYSTEM on NODEA:

\$ SHOW SYSTEM

OpenVMS V7.2 on node NODEA 15-DEC-1998 14:28:08.49 Uptime 0 01:05:15

Pid	Process Name	State	Pri	I/O	CPU	Page flts	Ph.Mem
22400201	SWAPPER	HIB	16	0 0	00:00:00.26	0	0
22400206	CONFIGURE	HIB	10	32 0	00:00:00.10	112	195
22400207	IPCACP	HIB	10	7 0	00:00:00.06	102	169
22400209	ERRFMT	HIB	8	46 0	00:00:00.10	84	144
2240020C	OPCOM	HIB	8	61 0	00:00:00.25	303	177
2240020D	AUDIT_SERVER	HIB	10	42 0	00:00:00.48	1355	438
2240020E	JOB_CONTROL	HIB	10	45 0	00:00:00.26	153	280
22400211	NETACP	HIB	10	94 0	00:03:16.13	8486	8374
22400212	EVL	HIB	6	218 0	00:00:00.75	2700	75 N
22400213	REMACP	HIB	8	8 0	00:00:00.04	65	58
22400218	SYSTEM	CUR	14	246 0	00:00:03.04	1225	293

Example: Displaying VAXCLUSTER Parameter

Use the System Generation utility (SYSGEN) to check the system parameter VAXCLUSTER on NODEA.

```
$ RUN SYS$SYSTEM:SYSGEN
```

```
SYSGEN> SHOW VAXCLUSTER
```

Parameter Name	Current	Default	Min.	Max.	Unit Dynamic
-----	-----	-----	-----	-----	-----
VAXCLUSTER	0	1	0	2	Coded-valu

```
SYSGEN>
```

Case Study Solution: OpenVMS Cluster System Booting Problem

Solution

NODEA is unable to boot the satellite node NODEC because NODEA is not a cluster member.

There are two ways you can correct this situation:

- If NODEA is not to be restored as a cluster member, configure NODEB as a boot server.
- Restore NODEA as a cluster member.

Configuring a Boot Server

Use the command procedure SYS\$MANAGER:CLUSTER_CONFIG.COM to enable NODEA as a boot server.

Restoring a Cluster Member

To restore NODEA as a cluster member:

1. On NODEA, use SYS\$MANAGER:CLUSTER_CONFIG.COM to reset the following:
 - NODENAME:
 - NETWORK ADDRESS:
 - ENABLE ETHERNET COMMUNICATIONS?
 - CLUSTER GROUP NUMBER:
 - QUORUM DISK (Y/N)?
 - ALLOCLASS:
2. The system will execute AUTOGEN GETDATA REBOOT. When it has rebooted, you can check your success.

3. On NODEA, enter SHOW CLUSTER and check the member status.

```
$ SHOW CLUSTER
```

```
View of Cluster from system ID 123456 node: NODEA 15-DEC-1998
09:53:44
```

```
+-----+-----+
|  SYSTEMS          | MEMBERS |
+-----+-----+
| NODE  | SOFTWARE | STATUS |
+-----+-----+
| NODEA | VMS V7.0 | MEMBER |
| JUST  | HSC V400 |        |
| NODEC | VMS V7.0 | MEMBER |
| LEGAL | HSC V400 |        |
| NODEB | VMS V7.0 | MEMBER |
+-----+-----+
```

4. On NODEA, run SYSGEN, and enter SHOW VAXCLUSTER.

```
$ RUN SYS$SYSTEM:SYSGEN
```

```
SYSGEN>SHOW VAXCLUSTER
```

Parameter Name	Current	Default	Min.	Max.	Unit	Dynamic
VAXCLUSTER	2	1	0	2	Coded-valu	

```
SYSGEN>EXIT
```

Case Study Problem: OpenVMS Cluster System Communication Problem

Problem Statement

You are the system and network manager for an OpenVMS Cluster system with two CI nodes.

You observe a series of error messages on the operator console and must determine their cause.

Example: Console Errors

The following errors are displayed on the operator console:

```
%CNXMAN, Lost connection to system NODEB
%PAA0, Software is Closing Virtual Circuit - REMOTE NODE NODEB
%PAA0, Path #0. Has gone from GOOD to BAD - REMOTE NODE HSC000
%PAA0, Path #0. Has gone from GOOD to BAD - REMOTE NODE HSC000
%CNXMAN, Re-established connection to system NODEB
$4$dua20: (HSC000) Online
%%%%%%%%%% OPCOM 15-DEC-1998 15:56:29.86 %%%%%%%%%%%
15:56:27:68 Node NODEA (CSID 00010006) lost connection to node NODEB
$4$dua26: (HSC000) Online
%%%%%%%%%% OPCOM 15-DEC-1998 15:56:29.87 %%%%%%%%%%%
15:56:28:27 Node NODEA (CSID 00010006) re-established connection to
node NODEB
$4$dua27: (HSC000) Online
%%%%%%%%%% OPCOM 15-DEC-1998 15:56:29.99 %%%%%%%%%%% from node NODEB
at
15-DEC-1998 15:56:28.95)
15:56:28:94 Node NODEB (CSID 00010001) lost connection to node NODEA
$4$dua101: (HSC000) Online
%%%%%%%%%% OPCOM 15-DEC-1998 15:56:29.99 %%%%%%%%%%% from node NODEB
at
15-DEC-1998 15:56:29.95)
15:56:28:88 Node NODEB (CSID 00010001) Re-established connection to
node NODEA
%PAA0, Path #1. Loopback has gone from GOOD to BAD
%PAA0, Path #0. Loopback has gone from GOOD to BAD
```

Example: SHOW CLUSTER /CONTINUOUS Output

The following is a view of the cluster from the SHOW CLUSTER/CONTINUOUS command:

```
$ SHOW CLUSTER/CONTINUOUS
```

View of Cluster from system ID 123456 node: NODEA 15-DEC-1998 16:23:44

```
+-----+-----+-----+
|  SYSTEMS      | MEMBERS | CIRCUIT |
+-----+-----+-----+
|  NODE   | SOFTWARE | STATUS  |  CABLE  |
+-----+-----+-----+
|  NODEA  | VMS V7.0 | MEMBER  |         |
|  JUST   | HSC V400 |         |         |
|  LEGAL  | HSC V400 |         |         |
|  NODEB  | VMS V7.0 | MEMBER  |         |
+-----+-----+-----+
```

Case Study Solution: OpenVMS Cluster System Communication Problem

Solution

The errors occurred because the CI cable to the HSC controller was disconnected.

After the CI cable is reconnected, the following messages appear:

```
%PAA0, Path #0. Loopback has gone from BAD to GOOD
```

```
%CNXMAN, RE-established connection to system NODEB
```

```
%%%%%%%%%% OPCOM 15-DEC-1998 15:57:27.79 %%%%%%%%%%%
```

```
15:57:27:74 Node NODEA (csid 00010006) re-established connection to  
node NODEB
```

```
$
```

Summary

Concepts

OpenVMS Cluster System Concepts

- OpenVMS Cluster system software components include system communications services, VAXport drivers, connection manager, distributed file system, distributed lock manager, distributed job controller, MSCP server, and the TMSCP server.
- OpenVMS Cluster system diagnostic messages important to troubleshooting OpenVMS Cluster system problems include connection manager messages, VAXport error messages, HSC error messages and fault conditions, error log entries, and DECnet event messages.
- Use the HSC SETSHO utility to diagnose cluster problems and to set parameters.
- Use the Network Control Program (NCP) to troubleshoot OpenVMS Cluster system problems.
- The connection manager initiates CLUEXIT bugchecks.

Failure of Nodes to Boot or Join the Cluster

- The connection manager on each cluster node is responsible for forming or joining the node to the OpenVMS Cluster system.
- When a CI node fails to boot or join the cluster, the problem may be with the node or with cluster components.
- When a satellite node fails to boot or join the cluster, you can use the boot node to research the problem.

Handling OpenVMS Cluster System Hangs

- Cluster state transition and inaccessible resources can cause the OpenVMS Cluster system to appear to hang.

Chapter Terms

bugcheck

A system crash caused by a severe internal software error.

quorum

Voting system that prevents a cluster from partitioning.

VAXCLUSTER

System parameter used to determine whether or not a booting node will attempt to form an OpenVMS Cluster system.

Learning Check

Questions

1. In the space provided, number each of the following system initialization events or landmarks to indicate the order in which they occur during a conversational boot.
 - a. VMB or APB runs
 - b. SYSTARTUP_VMS.COM runs
 - c. EXE\$INT is called
 - d. STARTUP.COM runs
 - e. SYSBOOT prompt appears
 - f. SYSINIT runs
 - g. EXE\$SWAPINIT runs

In the space provided, write the letter corresponding with the best answer to each of the following multiple-choice questions.

2. Testing a printer by despooling and using the COPY command to print a file on the printer is an attempt to:
 - a. Isolate the problem
 - b. Verify the solution
 - c. Propose a solution
 - d. Document the problem
3. If a user reports that his file did not print, which question will give you the most useful information regarding the problem?
 - a. What kind of file were you printing?
 - b. When did you print the file?
 - c. What command did you use to print the file?
 - d. What privileges do you have?
4. Which of the following *cannot* be done during a conversational boot at the SYSBOOT> prompt?
 - a. Specify another parameter file be used.
 - b. Change system parameters.
 - c. Edit the site-independent startup command file.
 - d. Display system parameters.

5. A minimum system initialization:
 - a. Ignores all errors in the startup command procedure
 - b. Does not invoke the site-specific startup command procedure
 - c. Sets the number of interactive users to 1
 - d. All of the above
6. Which processes are active after a minimum system initialization?
 - a. SWAPPER
 - b. IPCACP
 - c. ERRFMT
 - d. All of the above
7. Before you can use the full Backup utility when the system is initialized with the console as the startup command procedure, you must:
 - a. Install the required images.
 - b. Set the system parameter STARTUP to 1.
 - c. Delete the swapper process.
 - d. Define a symbol.
8. Which procedures can you use to boot the system when the site-independent startup file has been corrupted?
 - a. Run AUTOGEN.
 - b. Use an alternate site-independent startup file on the system disk.
 - c. Boot minimum.
 - d. Run SYSGEN.
9. If the system disk is broken, you can initialize the system by:
 - a. Running the Convert utility to make another disk the system disk
 - b. Using standalone Backup to restore a copy of the system disk to a spare disk
 - c. Using the console disk
 - d. None of the above
10. If the file SYSDUMP.DMP has been deleted from the system disk before the system crashes, the system dump file will be:
 - a. Lost
 - b. Written to a new file on another disk
 - c. Written to the system paging file
 - d. Written to a newly created SYSDUMP.DMP file on the system disk

11. Which of the following are written to the system dump file when the operating system fails?
 - a. Processor registers
 - b. System parameters
 - c. Operator log file
 - d. Cause of the crash
12. A nonfatal bugcheck:
 - a. Copies the contents of memory to the system dump file
 - b. Causes the system to crash
 - c. Results in an error log entry
 - d. Aborts normal system operation
13. The required size of the system dump file is determined by:
 - a. Size of memory
 - b. System parameter ERRORLOGBUFFERS
 - c. System parameter ERLBUFFERPAGES
 - d. All of the above
14. Which of the following is *not* a function of the ERRFMT process?
 - a. Reports the contents of the error log file
 - b. Formats standard error messages
 - c. Writes error messages regarding device errors to the error log buffers
 - d. Writes the error log buffers to a file on disk
15. If the node on which the queue manager process is running leaves the cluster:
 - a. All batch queues stop, but output queues continue if they are AUTOSTART.
 - b. The queue manager process fails over to another node.
 - c. All AUTOSTART queues stop.
 - d. All batch and print queues stop.
16. Which statement regarding the queue database files is true?
 - a. The queue file and the journal file must be located on the same disk.
 - b. All three files must be located on the system disk.
 - c. The three files can be located on three separate disks as long as the master file is on the system disk.
 - d. All three files must be located on the same disk.

17. Which statement regarding the connection manager in an OpenVMS cluster system is true?
 - a. The connection manager prevents cluster partitioning using the quorum scheme.
 - b. The connection manager controls the integrity of the cluster.
 - c. The connection manager uses SCS to provide an acknowledged message delivery service for the MSCP server.
 - d. All of the above.
18. If connection manager messages do not appear when the cluster systems are booting, you should suspect:
 - a. The console is turned off.
 - b. A cluster quorum does not exist.
 - c. The OpenVMS cluster system software was not loaded correctly.
 - d. All of the above.
19. Which NCP command can you use to display information about the state of a circuit?
 - a. SHOW KNOWN CIRCUIT CHARACTERISTICS
 - b. SHOW KNOWN LINE CHARACTERISTICS
 - c. SHOW KNOWN NODE
 - d. None of the above
20. Bugchecks initiated by the connection manager are called:
 - a. Nonfatal bugchecks
 - b. Fatal bugchecks
 - c. Cluster bugchecks
 - d. CLUEXIT bugchecks

Learning Check Answers

Answers

1. In the space provided, number each of the following system initialization events or landmarks to indicate the order in which they occur during a conversational boot
 - a. VMB or APB runs 1
 - b. SYSTARTUP_VMS.COM runs 7
 - c. EXE\$INT is called 3
 - d. STARTUP.COM runs 6
 - e. SYSBOOT prompt appears 2
 - f. SYSINIT runs 5
 - g. EXE\$SWAPINIT runs 4

In the space provided, write the letter corresponding with the best answer to each of the following multiple-choice questions.

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 - c. Cluster bugchecks
 - d. CLUEXIT bugchecks

Acronym List

A

Acronym	Term	Comments
AARP	AppleTalk Address Resolution Protocol	
AAT	array accelerator tracking	
ABM	Asynchronous Balanced Mode	
ABP	address-bit permuting	
ac/dc	alternating current/direct current	
ACA	Advanced Circuit Architecture	
ACC	asynchronous communications controller	
ACD	Automatic Call Distributor	
ACE	access control entry	Windows NT term
ACF (1)	application configuration file	
ACF (2)	attribute configuration file	
ACF/NCP	Advanced Communications Function for the Network Control Program	
ACF/VTAM	Advanced Communications Function for the Virtual Telecommunications Access Method	
ACI	access control information	
ACK	affirmative acknowledgment	
ACL	automatic cartridge loader	
ACM	associated count member	
ACSE	association control service element	
ACTLU	activate logical unit	
ACU (1)	Array Configuration Utility	
ACU (2)	automatic calling unit	
A/D	analog to digital (n); analog-to-digital (adj)	
ADCCP	advanced data communications control procedures	
ADE	application development environment	
ADJSSCP table	adjacent SSCP table	
ADMD	administration management domain	
ADSR	average data service rate	
AE	application entity	
AEC	Architectural, Engineering, and Construction	
AECC	Advanced Error Checking and Correcting	
AFPS	SCO Advanced File and Print Server	
AGP	Accelerated Graphics Port	
AID	attention identifier	
AIO	asynchronous input/output	
AK-TPDU	acknowledge transport protocol data unit	

ALPA	Arbitrated Loop Physical Address	
ALS	automatic line switching	
ALU	arithmetic logic unit	
AM (1)	amplitude modulation	
AM (2)	application manager	
AMD	American Micro Devices	Do not define
ANSI	American National Standards Institute	
AP	application process	
APC	Accelerator Peripheral Chip	
APDU	application protocol data unit	
API (1)	application program interface	To describe Guardian and Open System Services
API (2)	application programming interface	
APIC	Advanced Programmable Interrupt Controller	
APO	Adaptive Performance Optimization	
APPC	advanced program-to-program communication	
APPN	Advanced Peer-to-Peer Networking	
ARI/FCI	Address Recognized Indication/Frame Copied Indicator	
ARM (1)	Alarm/Reset Module	
ARM (2)	Asynchronous Response Mode	
ARP	Address Resolution Protocol	
ARP-PPDU	abnormal-release-provider presentation protocol data unit	
ASCII	American Standard Code for Information Interchange	Do not define
ASE (1)	Accredited Systems Engineer	Compaq ASE
ASE (2)	application service element	
ASI	additional service information	
ASIC	application-specific integrated circuit	
ASMP	Assymmetric multiprocessing	
ASPI	Advanced SCSI Programming Interface	
ASR	Automatic Server Recovery	
ASR-2	Automatic Server Recovery-2	
ATM (1)	Asynchronous Transfer Mode	
ATM (2)	automated teller machine	
ATM3SA	ATM 3 ServerNet adapter	
ATMI	Application-Transaction Monitor Interface	
ATP6100	Asynchronous Terminal Process 6100	
ATSB	air temperature sense board	
AU	access unit	
AUI	attachment unit interface	
AWAITIO	await input/output	
AWAN	asynchronous wide area network	

B

Acronym	Term	Comments
Basic	Beginners All-Purpose Symbolic Instruction Code	Initial cap only; do not define
BBI	begin bracket indicator	
BCB	breakpoint control block	
BCC	block-check character	
BCD	binary-coded decimal	
BCPU	backup central processing unit	
BCT	bus controller and terminator	
BDC	Backup Domain Controller	Windows NT term
BEB	back-end board	
BER (1)	Basic Encoding Rules	
BER (2)	bit error rate	
BETB	between brackets	
BI	Business Intelligence	
BIC	backplane interconnect card	
BID	board interface driver	
BIOS	basic input/output system	Do not define
BIS	bracket initiation stopped	
BIU (1)	basic information unit	
BIU (2)	bus interface unit	
BLIM	break-out-board line interface module	
BLOG	Background Logger	
BLT	block transfers	
BLU	basic link unit	
BMIC	bus master interface controller	
BMON	Background Monitor	
BNC	British Naval Connector	Do not define
BNF	Backus-Naur form	
BOB (1)	break-out board	
BOB (2)	break-out box	
BOF	beginning of file (n); beginning-of-file (adj)	
BOM	beginning of media (n); beginning-of-media (adj)	
BOT	beginning of tape (n); beginning-of-media (adj)	
BPT	breakpoint table	
BRT	bus receive table	
BSC	binary synchronous communication	
BSD	Berkeley Software Distribution	Trademark of the University of California, Berkeley
BSYS	Background System Process	
BTAM	basic telecommunications access method	
BTE	block transfer engine	

C

Acronym	Term	Comments
CAC	Central Arbitration Controller	
CAD	computer-aided design	Do not define
CAE (1)	common applications environment	
CAE (2)	computer-aided engineering	
CAID	creator access ID	
CAM (1)	Call Applications Manager	
CAM (2)	common access method	
CAM (3)	computer-aided manufacturing	
CAP	communications access process	
CAPI	Cryptographic Application Program Interface	Windows NT term
CAPS	Card Activation and PIN Selection	Compaq trademark
CASE	computer-aided software engineering	
CAU	channel adapter unit	
CAV	Constant Angular Velocity	
CBT	computer-based training	
CC (1)	communications controller	
CC (2)	condition code (n); condition-code (adj)	
CCE	condition code equal	
CCG	condition code greater than	
CCIM	computer communications interface module	
CCITT	Comité Consultatif International Télégraphique et Téléphonique	International Telegraph and Telephone Consultative Committee
CCL	condition code less than	
ccNUMA	Cache Coherent Non-Uniform Memory Access	
CCS	communications control subsystem	Compaq trademark
CD (1)	collision detection	
CD (2)	compact disc	Do not define
CDDI	copper distributed data interface	
CDI	change direction indicator	
CDINIT	cross-domain initiate	
CDRAM	cached dynamic RAM	
CDRM	cross-domain resource manager	
CD-ROM	compact disc read-only memory	Do not define
CDRSC	cross-domain resource	
CDT	Central daylight time	
CEPI	connection endpoint identifier	
CGA	color graphics adapter	Do not define
CGI	Common Gateway Interface	
CHAP	Challenge Handshake Authentication Protocol	
CHAP/PAP	Challenge Handshake Authentication Protocol/Password Authentication Protocol	
CICS	Customer Information Control System	IBM trademark
CIM	computer-integrated manufacturing	

CINIT	control initiate	
CISC	complex instruction-set computing	
CIU	communications interface unit	
CLB	CIU-to-LIU bus	
CLI (1)	call-level interface	
CLI (2)	command line interface	
CLIP	communications line interface processor	
CLNS	connectionless-mode network service	
CLT	CLIP line task	
CLV	Constant Linear Velocity	
CMA	Cluster Management Application	
CMC (1)	cabinet monitoring controller	
CMC (2)	Continuous Media Controller	
CMDB (1)	cabinet maintenance and diagnostic bus	
CMDB (2)	controller maintenance and diagnostic bus	
CMDP	controller maintenance and diagnostic processor	
CMDSVR	Command Server Process	
CME	correctable memory error	
CMF	cabinet monitoring facility	
CMI	Communications Management Interface	
CMIP	Common Management Information Protocol	
CMON	Command Interpreter Monitor	
CMOS	complementary metal oxide semiconductor	Do not define
CMP	communications management process	
CNA	communications network architecture	
CNM	communications network management	
COBOL	Common Business-Oriented Language	Do not define
COFF	common object file format	
COM (1)	Component Object Model	
COM (2)	computer output microfilmer	Do not define
COMA	Cache Only Memory Architecture	
CONS	connection-mode network service	
CORBA	Common Object Request Broker Architecture	
COS	class of service	
COUP	Configuration Utility Program	
CPB	control processor board	
cps	characters per second	
CPU	central processing unit	Do not define; preferable term is <i>processor</i>
CR/LF	carriage return/line feed (n, adj)	
CRC	cyclic redundancy check	
CRE	Common Run-Time Environment	
CRIF	Creater interface	
CRM	Customer Relationship Management	
CRT	cathode-ray tube	Do not define
CRU	customer-replaceable unit	

CRVSN	creation version serial number
CSC	Common Session Control
CSM	Communications Subsystem Manager
CSMA	carrier sense multiple access
CSMA/CD	carrier sense multiple access with collision detection
CSS (1)	communications subsystem
CSS (2)	Core Switching Services
CSSEG table	current short segment table
CST	Central standard time
CTERM	control terminate
CTL table	controller table
CTS	clear to send
CU	control unit
CUA	Common User Access
CUG	closed user group
CUP	Communications Utility Program
CUT	controller unit table
CWS	Craft Workstation

D

Acronym	Term	Comments
D/A	digital to analog (n); digital-to-analog (adj)	
DAA	Data Access Management	
DAAD	Drive Array Advanced Diagnostics	
DAC	digital analog converter	
DACL	discretionary access control list	Windows NT term
DAI	disk application interface	
DAK	Data Access Language	
DAM	Data Access Manager	
DAT	digital audio tape	
DAVFU	direct-access vertical-format unit	
dB	decibel	
DBA	database administrator	
DBCS	double-byte character set	
DBLIB	DB-LIBRARY	
DBMS	database management system	
dc	direct current (n); direct-current (adj)	
DCA	document content architecture	
DCB	device control block	
DCC	digital content creation	
DCD	data carrier detect	
DCE (1)	data circuit-terminating equipment	
DCE (2)	Distributed Computing Environment	
DCF	dynamic configuration file	
DCL	Data Control Language	
DCLZ	Data Compression Lempel Ziv	
DCOM (1)	Disk Compression Program	
DCOM (2)	Distributed Component Object Model	OLE and Active-X term
DCOM (3)	Distributed Component Object Module	Windows NT term
DCT	destination control table	
DDC	Display Data Channel	
DDCMP	Digital Data Communications Message Protocol	
DDE	Dynamic Data Exchange	
DDF	dictionary definition file	
DDL	Data Definition Language	
DDLTRANS	Data Definition Language translator	
DDN	Defense Data Network	
DDP	Datagram Delivery Protocol	
DDS	Digital Data Storage	
DDS-DC	Digital Data Storage Data Compression	
DDT	diagnostic data transceiver	
DES	data entry system	
DESTSA	destination subarea	

DFC (1)	data flow control	
DFC (2)	data forward count	
DFS (1)	data forward size	
DFS (2)	disk free space	
DFT (1)	data forward time	
DFT (2)	disk format tape	
DHCP	Dynamic Host Configuration Protocol	
DIB (1)	Data Interface Buffer	
DIB (2)	device-independent bitmap	
DIB (3)	Dual Independent Bus	
DIMM	dual inline memory module	
DIN connector	Deutsche Industrinorm connector	
DIP	dual inline package	
DL	distribution list	
DLC	data link control	
DLE	data link escape	
DLL	dynamic-link library	
DLM (1)	Distributed Lock Manager	
DLM (2)	download module	
DLT	digital linear tape	
DLU	destination logical unit	
DMA	direct memory access	
DMAC	Design and Modeling Advisory Council	
DMB	dual maintenance bus	
DMI	Desktop Management Interface	
DML	Data Manipulation Language	
DMS	diagnostic monitoring system	
DMTF	Desktop Management Task Force	
DNA	Digital Network Architecture	
DNIC	data network identification code	
DNS (1)	Distributed Name Service	
DNS (2)	Domain Name Service	
DNS (3)	Domain Name System	Windows NT term
DOA	Distributed Office Application	
DOS	disk operating system	Do not define
DP	dual processing	
DP1	Disk Process 1	
DP2	Disk Process 2	On NonStop® Kernel systems
DPT	drive parameter tracking	
DR1I	definite response 1 indicator	
DR2I	definite response 2 indicator	
DRAM	dynamic RAM	
DRM	Data Replication Manager	
DRT	diagnostic restore tape	

DS	Distribution Service
DSAP	Disk Space Analysis Program
DSC	Dynamic System Configuration
DSM (1)	distributed shared memory
DSM (2)	Distributed Systems Management
DSM/PM	Distributed Systems Management/Problem Manager
DSM/SCM	Distributed Systems Management/Software Configuration Manager
DSM/SNA View	Distributed Systems Management/SNA View
DSM/TC	Distributed Systems Management/Tape Catalog
DSMA	Distributed Systems Management Application
DSMS	Distributed Systems Management Solutions
DSNM	Distributed Systems Network Management
DSO	Distributed Systems Option
DSP	Directory System Protocol
DSR (1)	data set ready
DSR (2)	dynamic sector repair
DSS (1)	decision support system
DSS (2)	dynamic support system
DST	daylight-saving time
DSV	distribution subvolume
DTC	Distribution Transaction Coordinator
DTE	data terminal equipment
DTMF (1)	Dual Tone Modulated Frequency
DTMF (2)	Dual Tone Multi-Frequency
DTP	distributed transaction processing
DTR	data terminal ready
DUA	directory user agent
DUART	Dual Universal Asynchronous Transmitter
DV	distance vector
DWF	Distributed Workbench Facility

E

Acronym	Term	Comments
E4SA	Ethernet 4 ServerNet adapter	
EAP	Early Adopter Program	
EBC	extended system bus controller	
EBCDIC	extended binary-coded decimal interchange code	
EBM	enhanced battery management	
EBS	Enterprise Backup Solution	
ECB	event control blocks	
ECC (1)	error checking and correcting	
ECC (2)	error-correcting code	
ECHS	extended cylinder head sector	
ECI	Enhanced Command Interface	
ECMA	European Computer Manufacturers Association	
ECP	Enhanced Capability Port	
EDA	electronic design automation	
EDI	Electronic Data Interchange	
EDIFACT	Electronic Data Interchange for Administration, Commerce, and Transport	
EDO	Extended Data Out	
EDT	Eastern daylight time	
EEPROM	electrically erasable programmable ROM	
EFS	Extended Features Supplement	
EGA	enhanced graphics adapter	Do not define
EIA	Electronic Industries Association	
EIDE	enhanced IDE (integrated drive electronics)	
EIGRP	Enhanced Interior Gateway Routing Protocol	
EIO	execute I/O	
EISA	Extended Industry Standard Architecture	Do not define
EIT	encoded information type	
EMCOM	emulator command interpreter	
EMI	electromagnetic interference	
EMS	Event Management Service	
EMU	Environmental Monitoring Unit	
ENA	extended network addressing	
ENSA	Enterprise Network Storage Architecture	
EOF (1)	end of file (n); end-of-file (adj)	
EOF (2)	end of frame (n); end-of-frame (adj)	
EOJ	end of job (n); end-of-job (adj)	
EOM	end of media (n); end-of-media (adj)	
EOT (1)	end of tape (n); end-of-tape (adj)	
EOT (2)	end of text (n); end-of-text (adj)	
EOT (3)	end of transmission (n); end-of-transmission (adj)	
EPO	emergency power off	
EPP	Enhanced Parallel Port	
EPROM	erasable programmable ROM	

ERA	Extended Repeater Architecture
ERD	emergency repair diskette
ERP	Enterprise Resource Planning
ESA (1)	Extended Storage Architecture
ESA (2)	extended subarea addressing
ESC	escape control character
ESD	electrostatic discharge
ESIOP	Environment-Specific Inter Orb Protocol
ES-IS	end system to intermediate system routing exchange protocol
ESM	Enterprise Storage Manager
ESP (1)	executor server process
ESP (2)	expansion service processor
EST	Eastern standard time
ETR	extended tag RAM

F

Acronym	Term	Comments
FAP	frame alarm panel	
FAT	file allocation table	
FC-AL	Fibre Channel Arbitrated Loop	
FC-PL	Fibre Channel Public Loop	
FC-SW	Fibre Channel Switched Fabric	
FCS	first customer shipment	Internal only
FDDI	fiber distributed data interface	
FDM	frequency-division multiplexing	
FDX	full duplex (n); full-duplex (adj)	
FEA	Fast Ethernet Alliance	
FESA	Fast Ethernet ServerNet adapter	
FF	form feed (n)	
FIFO	first-in-first-out	
FIPS	Federal Information Processing Standard	
FIR	FRU information record	
FM	frequency modulation	
FMD	function management data	
FORTTRAN	Formula Translation	
FOX	Fiber Optic Extension	Compaq trademark
FOXII	Fiber Optic Extension II	Compaq trademark
FPGA	field-programmable gate array	
FPM	Fast Page Mode	
FPU	floating-point unit	
FQDN	fully qualified domain name	Windows NT term
FRU	field-replaceable unit	
FSAP	file system access point	
FSK	frequency-shift keying	
FSM	finite state machine	
FSP	file service process	
FTAM	File Transfer, Access, and Management	
FTP	file transfer protocol	
FUP	File Utility Program	
FXSA	ServerNet/FX adapter	

G

Acronym	Term	Comments
GAU	gateway access unit	
GBIC	Gigabit Interface Converter	
GBIC-LW	longwave Gigabit Interface Converter	
GBIC-SW	shortwave Gigabit Interface Converter	
GCR	group code recording	
GCSC	Global Customer Support Center	Not Tandem NonStop™ Support Center (TNSC)
GDI	graphics device interface	
GDS	General Device Support	
GDSX	Extended General Device Support	
GFS	Grandfather-Father-Son	Tape rotation method for backups
GMM	Global Memory Manager	
GMT	Greenwich mean time	
GOSIP	Government OSI Protocol	
GPI	graphics programming interface	
GPR	general-purpose register	
GSD	Graphics Support Diskette	
GSM	Global System for Mobile Communication	
GUI	graphical user interface	
GWNCP	gateway NCP	
GWSSCP	gateway SSCP	

H

Acronym	Term	Comments
HAL	hardware abstraction layer	
HALT	Highly Accelerated Life Testing	
HASP	Houston Automatic Spooling Program	
HBA	host bus adapter	
HBC	Himalaya system bus controller	
HDC (1)	hard disk controller	
HDC (2)	hardware data compression	
HDLC	high-level data-link control	
HDX	half duplex (n); half-duplex (adj)	
HF	high frequency (n); high-frequency (adj)	
HMI	hub management interface	
HMMO	Hyper-Media Management Object	
HSCM	high-speed serial compression module	
HSM	hardware specific module	
HSSP	high-speed switch port	
HTML	Hypertext Markup Language	Do not define
HTTP	Hypertext Transfer Protocol	Do not define
HW	hardware	Do not use acronym in text

I

Acronym	Term	Comments
IA5	International Alphabet No. 5	
IANA	Internet Assigned Numbers Authority	
IC	integrated circuit	
ICMP	Internet Control Message Protocol	
ID	identification (or identifier)	Do not define
IDA	Intelligent Drive Array	Do not define
IDE	integrated drive electronics	Do not define
IDL	Interface Definition Language	
IDS	intelligent device support	
IDU	internal data unit	
IEC	International Electro-technical Commission	
IEEE	Institute of Electrical and Electronics Engineers, Inc.	Do not define
IETF	Internet Engineering Task Force	
I-frame	information frame	
IGRP	Interior Gateway Routing Protocol	
IHV	independent hardware vendor	
IIO	interrogate I/O	
IIOB	Internet Interoperable Object Protocol	
IIS	Internet Information Server	Windows NT term
IMC	integrated maintenance controller	
IMD	Integrated Management Display	
IMS	Information Management System	
INMC	Inter-NET/MASTER Connection	
INS/CO	INS Communications Server	
INT	Interrupt	Do not define
I/O	input/output	Do not define (I-O in COBOL)
IOC table	I/O control table	
IOMF CRU	I/O multifunction CRU	
IOP	I/O process	
IOPRM	I/O process request manager	
IOPSL	I/O process server layer	I/O request message
IOS	I/O subsystem	
IP (1)	Independent Product	
IP (2)	Internet Protocol	Do not define
IPB	interprocessor bus	
IPBMON	interprocessor bus monitor	
IPC	interprocess (or interprocessor) communication	
IPG	inter-packet gap	
IPM	interim product modification	

ips	inches per second	
IPS (1)	interruptible power source	
IPS (2)	interruptible power supply	
IPU	instruction processing unit	
IPX	Internet Packet Exchange	Do not define
IPX/SPX	Internet Packet Exchange/Sequenced Packet Exchange	Do not define; Novell trademark
IR	incident report	
IRQ	interrupt request	Do not define
IS	Information Services	
ISA	Industry Standard Architecture	Do not define
ISDN	integrated services digital network	
ISO	International Organization for Standardization	Not an acronym; derived from the Greek word <i>iso</i> , which means <i>equal</i>
ISP (1)	intelligent SCSI processor	
ISP (2)	Internet Service Provider	
ISV (1)	independent software vendor	
ISV (2)	installation subvolume	
ITB	intermediate text block	
ITI	interactive terminal interface	
iTP	Internet Transaction Processing	Compaq trademark (<i>I</i> is always lowercase)
ITU	International Telecommunication Union	
ITUG	International Tandem Users' Group	
IXF	Information Xchange Facility	Compaq trademark

J

Acronym	Term	Comments
JDBC	Java Database Connector	

K

Acronym	Term	Comments
KDF	key definition file	
KMSF	Kernel-Managed Swap Facility	

L

Acronym	Term	Comments
LADR	load address	
LAN	local-area network	Do not define
LAP	link access procedure	
LAPB	link access procedure balanced	
LB	logic board	
LBA	logical block addressing	
LBU	local bus unit	
LCB	link control block	
LCD	liquid crystal display	Do not define
LCGN	logical channel group number	
LCN	logical channel number	
LCS	loadable control store	
LCT	local civil time	
LDAP	Lightweight Directory Access Protocol	
LDEV	logical device	
LDIB	Local Directory Information Base	
LED	light-emitting diode	Do not define; use <i>an</i> , not <i>a</i> , with LED
LEM	loop expansion module	
LF	line feed (n, v); line-feed (adj)	
LIF	logical interface	
LIM	line interface module	
LIP	Large Internet Packet	
LIU	line interface unit	
LLC	Logical Link Control	
LMIB	Local Management Information Base	
LMU	logical memory unit	
LOGP	Activity Log Process	
LRC	longitudinal redundancy check	
LRU	least recently used	
LSB	least significant bit (or byte)	
LSI	large scale integration	
LSL	link support layer	
LST	local standard time	
LU	logical unit	
LUN	logical unit number	
LUNS	LU Network Services	
LVDS	low-voltage differential SCSI	

M

Acronym	Term	Comments
MA	memory array	
MAC (1)	media access control	
MAC (2)	memory access controller	
MAM	Management Application Modul	
MAP	Manufacturing Automation Protocol	
MAT	master audit trail	
MAU (1)	Media Access Unit	
MAU (2)	medium attachment unit	
MAU (3)	Multistation Access Unit	
MBCT	modular bus controller and terminator	
MBE	maintenance bus extender	
MBR	maintenance bus repeater	
MCA	Micro Channel Architecture	
MCAD	mechanical computer-aided design	
MCB board	memory control and interprocessor bus board	
MCI	media control interface	
MCU	memory control unit	
MCW	message control word	
MD	management domain	
MDAM	MultiDimensional Access Method	
MDB	maintenance and diagnostic bus	
MDO	mapped data object	
MDP	maintenance and diagnostic processor	
MDS	maintenance and diagnostic subsystem	
MDT (1)	modified data tag	
MDT (2)	Mountain daylight time	
MEP	media expansion port	
MESI	modified/exclusive/shared/invalid	
MF-8 I/O cabinet	multifunction 8 I/O cabinet	
MFC	multifunction controller	
MFIOB	multifunction I/O board	
MFM	module file management	
MH	message handling	
MHS	message handling system	
MIB	Management Information Base	
MIC (1)	media interface controller	
MIC (2)	memory in chip	
MIF	Management Information Format	
MII	media independent interface	
MIME	Multipurpose Internet Mail Extension	
MIOC	Memory and I/O Controller	
MIOP	maintenance I/O process	
MIPS	million instructions per second	
MLAD	Multilan attachment device	

MLF	monthly license fee	
MLID	multiple link interface driver	
MMBR	modular maintenance bus repeater	
MMC	Microsoft Management console	
MMI	media module interface	
MMX	multimedia instructions	
MOLP	Multiple Open License Pack	
MOTIS	Message-Oriented Text Interchange System	
MP	multiprocessing	Do not define
MPDU	message protocol data unit	
MPP	massively parallel processing	
MPR	MultiProtocol Router	
MPS	master password server	
MQC	message quick cell	
MR	message relay	
MRL	merge onto ready list	
MRP	message relay process	
MRU	most recently used	
MS	message store	
MSACD	modular system automatic configuration detector	
MSB	most significant bit (or byte)	
MSBE	modular system bus extender	
MSBF	mean swaps before failure	
MSBIE	modular system bus and I/O bus extender	
MSBIR	modular system bus and I/O bus repeater	
MSBR	modular system bus repeater	
MSBT	modular system bus terminator	
MSG	maintenance and service guide	
MSH	modified split horizon	
MSL	mirrored server link	
MSM	media support module	
MSP	master service processor	
MSSQ set	multiple server single queue set	
MST	Mountain standard time	
MT	message transfer	
MTA	message transfer agent	
MTBDL	mean time between data loss	
MTBF	mean time between failures	
MTC	magnetic tape controller	
MTDA	mean time to data access	
MTL	message transfer layer	
MTS	message transfer system	
MTTR	mean time to repair	
MTU	magnetic tape unit	
MU	memory unit	
MUX	multiplex	

N

Acronym	Term	Comments
NAC	network adapter card	
NACK	negative acknowledgment	
NAM	Network Access Method	
NAU	network addressable unit	
NBEXEC	NetBatch NonStop® executor program	
NBP	Name Binding Protocol	
NBS	National Bureau of Standards	
NCB	network control block	
NCL	Network Control Language	
NCP (1)	NetWare Core Protocol	
NCP (2)	network control process	
NCP (3)	Network Control Program	
NCPM	network control process messages	
NCS	national character support	
NCSA	National Center for Supercomputing Applications	
NCU	NonStop® Clusters for UnixWare	
NDIS	Network Driver Interface Specification	
NDS	NetWare Directory Services	
NEBS	Network Equipment-Building System	
NetBEUI	NetBIOS extended user interface	Do not define
NetBIOS	network basic input/output system	Do not define
NETMON	network monitor	
NFF	new form factor	
NFS	Network File System	Trademarks of Sun Microsystems, Inc. (acronym and term)
NIA	network interface adapter	
NIC (1)	Network Information Center	
NIC (2)	network interface card (or controller)	
NIS	Network Information Service	
NIST	National Institute of Standards and Technology	
NLM	NetWare Loadable Module	
NLS	National Language Support	
NLSP	NetWare Link Service Protocol	
NMC	Network Management Console	
NMI	non-maskable interrupt	
NNM	NonStop® NET/MASTER	
NOCC	Network Operation Control Center	
NOETR	No Early Token Release	Do not define
NORMA	No Remote Access Memory	
NOS	network operating system	Do not use acronym in text

NPFC	NetWare Programs From Compaq	
NPFCS	NetWare Programs From Compaq Supplemental	
NRD (1)	named resource descriptor	
NRD (2)	non-roll-delete (adj)	
NRL	named resource list	
NRM	Normal Response Mode	
NRT	network routing table	
NRZI	nonreturn to zero inverted	
NSAN	NonStop® Access for Networking	
NSAP	network service access point	
NSDS	NonStop® Directory Services	
NSM	NetWare Management System	Novell term
NSP	network service provider	
NST	network status table	
NSX	Network Statistics Extended	
NTFS	NT file system	Exception to the rule that NT must always be preceded by Windows
NUMA	Non-Uniform Memory Access	
NVRAM	nonvolatile RAM	
NVT	Novell Virtual Terminal	

O

Acronym	Term	Comments
OBL	object build list	
OCB	object control block	
OCR	optical character recognition	
OCS	Operator Control Services	
ODBC (1)	Object Database Connector	
ODBC (2)	Open Database Connectivity	
ODF	object definition file	
ODI	Open Datalink Interface	
ODM	Online Data Manager	
ODP	optical disk process	
OEM	original equipment manufacturer	Do not define
OLE	Object Linking and Embedding	Do not define
OLTP	Online Transaction Processing	
OMF	Object Monitoring Facility	
OMG	Object Management Group	
OPS	Oracle Parallel Server	
OR	originator/recipient (adj)	
ORB	object request broker	
OS	operating system	Do not use acronym in text
OSC	Online Support Center	
OSF	Optical Storage Facility	
OSI	Open Systems Interconnection	Do not define
OSI/AS	Open Systems Interconnection/Application Services	
OSI/MHS	Open Systems Interconnection/Message Handling System	
OSI/TS	Open Systems Interconnection/Transport Services	
OSIMAGE	operating system image	
OSP	Operations and Service Processor	
OSPF	Open Shortest Path First	
OSS	Open System Services (adj)	
OTF	object text file	
OU	option unit	

P

Acronym	Term	Comments
PAD	packet assembler/disassembler	
PAID	process access ID	
PAL	programmable array logic	
PAM (1)	Port Access Method	
PAM (2)	pulse amplitude modulation	
PAP	Password Authentication Protocol	
PBC	port bypass circuit	
PBX	private branch exchange	
PC	personal computer	Do not define
PCA	Parallel Channel Architecture	
PCB (1)	printed circuit board	
PCB (2)	process control block	
PCBX	process control block extension	
PCI (1)	peripheral component interconnect	Do not define
PCI (2)	protocol control information	
PCID	presentation context identifier	
PCM	pulse code modulation	
PCMCIA	Personal Computer Memory Card International Association	Do not define
PCON	protected converter	
PD	physical delivery	
PDAU	physical delivery access unit	
PDB	performance database	
PDC	primary domain controller	
PDF	Portable Document Format	
PDN	public data network	
PDP	power distribution panel	
PDS	physical delivery system	
PDT (1)	Pacific daylight time	
PDT (2)	physical device table	
PDU (1)	power distribution unit	
PDU (2)	protocol data unit	
PE (1)	phase-encoded	
PE (2)	processing element	
PEM	Privacy Enhanced Mail	
PEMF	power and environmental monitoring facility	
PEP table	procedure entry-point table	
PFS	process file segment	
PIB (1)	power interface board	
PIB (2)	program information block	
PIC	plug-in card	
PICs	protocol implementation conformance statement	
PIF (1)	physical interface	
PIF (2)	program information file	Windows NT term
PIN (1)	personal identification number	
PIN (2)	process identification number	

PIP	power interconnect panel	
PLA	peripheral line adapter	
plc	public limited company	
PLD	program license diskette	
PLU	primary logical unit	
PM (1)	per-message	
PM (2)	phase modulation	
PM (3)	product module	
PMB	processor and memory board	
PMCU	power monitor and control unit	
PMF CRU	processor multifunction CRU	
PMI	Processor Maintenance Interface	
PMM	power monitoring module	
PNA	Programmatic Network Administrator	
POS	point of sale (n); point-of-sale (adj)	
POSIX	portable operating system interface	Do not define
POST	power-on self-test	
PPD	process-pair directory	
PPDU	presentation protocol data unit	
PPL	process-pair list	
PPM	processor power module	
ppm	pages per minute	
PPP	Point-to-Point Protocol	
PR	per-recipient	
PRMD	private management domain	
PROM	programmable read-only memory	Do not define
PSAP	presentation service access point	
PSDN	packet-switching data network	
PSEL	presentation selector	
PSM	platform-specific module	
pSOS	Portable Silicon Operating System	The <i>p</i> is lowercase
PSP	peer service processor	
PSS	power supply sense	
PST (1)	Pacific standard time	
PST (2)	process segment table	
pTAL	Portable Transaction Application Language	The <i>p</i> is lowercase
PTP	Parallel Transaction Processing	Compaq trademark
PTR	printer protocol	
PTS	Presentation Transfer Syntax	
PU	physical unit	
PUCB	program-unit control block	
UCP	physical unit control point	
PUP	Peripheral Utility Program	
PVA	Power Verification and Address	
PVC	permanent virtual circuit	
PWA	printed wiring assembly	
PWB	printed wiring board	

Q

Acronym	Term	Comments
QP	query processor	
QUICC	quad-integrated communications controller	

R

Acronym	Term	Comments
RAC	reconnect address controller	
RAID	Redundant Array of Inexpensive (or Independent) Disks	Do not define
RAIT	Redundant Array of Inexpensive (or Independent) Tape	
RAL	resource access layer	
RAM	random access memory	Do not define
RARP	Reverse Address Resolution Protocol	
RAS	Remote Access Service	
RBA	relative byte address	
RCP	Remote Console Process	
RDBMS	relational database management system	
RDF	Remote Duplicate Database Facility	Compaq trademark; do not use to mean <i>record description file</i>
RECFMS	Record Formatted Maintenance Statistics	
REJ	Reject	
RF	radio frequency	
RFC	Requests for Comments	
RFI	radio frequency interference	
RH	request/response header	
RIP	Routing Information Protocol	
RISC	reduced instruction-set computing	Do not define
RJE	remote job entry	
RMI	Remote Maintenance Interface	
RMIP	Remote Maintenance Interface Process	
RMON	remote monitoring	
RNR	Receive Not Ready	
ROF	Remote Operations Facility	
ROM	read-only memory	Do not define
ROM BIOS	read-only memory basic input/output system	Do not define
ROS	remote operations service	
ROSE	remote operations service element	
RP	register pointer	
RPC	Remote Procedure Call	
RPC Locator service	Remote Procedure Call Locator service	Windows NT term
RPC Name service	Remote Procedure Call Name service	Windows NT term
RR	Receive Ready	

RSC	Remote Server Call	
RSL	registry size limit	Windows NT term
RSO	Recovery Server Option	
RTC (1)	real-time clock	
RTC (2)	Regional Technology Centers	
RTS (1)	reliable transfer service	
RTS (2)	request to send	
RTSE	reliable transfer service element	
RTTI	run-time type identification	
RU (1)	request/response unit	
RU (2)	response unit	
RUCB	run-unit control block	
RVI	reverse interrupt	

S

Acronym	Term	Comments
SABM	Set Asynchronous Balanced Mode	
SAC	ServerNet addressable controller	
SAD	ServerNet address domain	
SAM	security accounts manager	Windows NT term
SAN (1)	storage area network	
SAN (2)	system area network	
SAP (1)	Service Advertising Protocol	
SAP (2)	system alarm panel	
SBB	ServerNet buffer board	
SBC	system bus controller	
SBE	system bus extender	
SBI	ServerNet bus interface	
SBIE	system bus and I/O bus extender	
SBR	system bus repeater	
SBT	system bus terminator	
SCC	serial communications controller	
SCF	Subsystem Control Facility	
SCI	Scalable Coherent Interface	
SCP (1)	Service Control Point	
SCP (2)	Subsystem Control Point	
SCP (3)	system control panel	
SCSI	small computer system interface	Do not define
SCUP	SCREEN COBOL Utility Program	
SD	Security Descriptor	Windows NT term
SDK	Software Development Kit	
SDLC	synchronous data-link control	
SDN	subdevice number	
SDRAM	synchronous dynamic random access memory	
SEB	ServerNet expansion board	Use <i>an</i> , not <i>a</i> , with SEB
SEC	single-edge contact	
SEEROM	serial electronically erasable read-only memory	
SFT	System Fault Tolerance	
SGRAM	synchronous graphics RAM	
SH	split horizon	
SIC	standard industry classification	
SID (1)	Security Identifier	Windows NT term
SID (2)	system image disk	
SIE	Session Initiation Exit	
SIM	SCSI Interface Module	
SIMD	Single Instruction, Multiple Data	
SIMM	single inline memory module	
SIO	sequential I/O	
SISO	shift in/shift out	
SIT	system image tape	

S.M.A.R.T.	Self-Monitoring Analysis and Reporting Technology	
SIV	system interrupt vector	
SLB	serial link board	
SLIP	Serial Line IP	
SLR	single linear recording	
SLSA	ServerNet LAN Systems Access	
SLU	secondary logical unit	
SMART	SCSI Managed Array Technology	Do not define
SMB (1)	Small-to-Medium Business	
SMB (2)	serial maintenance bus	
SMB (3)	Server Message Block	
SMC	system maintenance controller	
SMDS	Switched Multimegabit Data Service	
SMF	Storage Management Foundation	
SMI (1)	ServerNet memory interface	
SMI (2)	Structure of Management Information	
SMP	symmetric multiprocessing	
SMP	Simple Management Protocol	
SMS	Systems Management Server	Microsoft product
SMT	SWAN manager task	
SMTP	Simple Mail Transfer Protocol	
SNA	Systems Network Architecture	Do not define
SNAK	Serial Number Activation Key	
SNALU	SNAX Application Logical Unit	
SNAX/APC	SNAX Advanced Program Communication	
SNAX/CDF	SNAX Cross-Domain Facility	
SNAX/HLS	SNAX High-Level Support	
SNAX/XF	SNAX Extended Facility	
SNI	SNA network interconnection	
SNMP	Simple Network Management Protocol	
SNPA	subnetwork point of attachment	
SNRM	Set Normal Response Mode	
SOF	start of frame	
SOH	start of heading	
SOHO	Small Office, Home Office	
SOS	SmartStart Ordering System	
SPAD	scratchpad	
SPDU	session protocol data unit	
SPI	Subsystem Programmatic Interface	Use <i>an</i> , not <i>a</i> , with SPI
SPIFF	Software Problem Isolation, Fix Facility	
SPR	symmetric phase recording	
SPX	Sequenced Packet Exchange	
SQL	structured query language	Use <i>an</i> , not <i>a</i> , with SQL
SQLCI	SQL conversational interface	

SRAM	static RAM	Do not define
SRL	shared run-time library	
SSCP	system services control point	
SSD	Software Support Diskette	
SSEL	session selector	
SSI log	System Service Information log	
STP	Shielded Twisted Pair	Do not define
STX	start of text	
SUT	site update tape	
SVC	switched virtual circuit	
SVGA	super video graphics adapter	Do not define
SVID	System V Interface Definition	
SW	software	Do not use acronym in text
SWAN concentrator	ServerNet WAN concentrator	
SWID	Software Identification	
SWIFT	Society for Worldwide Interbank Financial Telecommunications	
SYN	synchronous idle	

T

Acronym	Term	Comments
TAP	Telocator Alphanumeric Protocol	
TAPS	Tandem application, presentation, and session	
TAREQ	TRANSFER asynchronous requester	
TCB	task (or time) control block	
TCP (1)	terminal control process	
TCP (2)	Transmission Control Protocol	Do not define
TCP/IP	Transmission Control Protocol/Internet Protocol	Do not define
TCQ	tagged command queuing	
TD	Transaction Distributor	
TFDS	Tandem Failure Data System	
TFILE	pseudofile	
TFTP	Trivial File Transfer Protocol	
TG	transmission group	
TH	transmission header	
THL	Tandem HyperLink	
TIA	Telecommunications Industry Association	
TIL	Tandem-to-IBM Link	
TIM	Total Information Manager	Compaq trademark
TISERV	TRANSFER interactive server	
TLAM	Tandem LAN Access Method	
TLAN	ThunderLAN	
TLB	translation lookaside buffer	
TLCD	time-list control block	
TLE	time-list element	
TLI	Transport Layer Interface	
T/Mail	TRANSFER/Mail	
TM	Transaction Manager	
TMDS	Tandem Maintenance and Diagnostic System	
TMF	Transaction Management Facility	Trademark
TMP	TM management process	
TNS	Tandem NonStop® Series	Use acronym only as an adjective
TNS/R	Tandem NonStop® Series/RISC	Use acronym only as an adjective
TPC	Transaction Processing Council	
TPDU	transport protocol data unit	
TR	Token-Ring	
transid	transaction identifier (n); transaction-identifier (adj)	
TRSA	Token-Ring ServerNet adapter	
TSAP	transport service access point	
TSDU	transport service data unit	
TSEL	transport selector	

TSIMS	Tandem Scalable Internet Messaging System	Trademark
TSM (1)	Tandem Service Management	Use only as an adjective
TSM (2)	Topology Support Module	
TSO	time-sharing option	
TSP	transport service provider	
TSQL	Transact-SQL	
TTD	temporary text delay	
TTE	Tandem terminal emulator	

U

Acronym	Term	Comments
UA	user agent	
UAL	user agent layer	
UART	universal asynchronous receiver-transmitter	
UCME	uncorrectable memory error	
UDP	User Datagram Protocol	
UHF	ultra high frequency	
UMA	Uniform Memory Access	
UMP	unsolicited-message processing	
UMPDU	user message protocol data unit	
UNC	universal naming convention	Windows NT term
UOW	unit of work (n); unit-of-work (adj)	
UP	uniprocessor	
UPS (1)	uninterruptible power source	
UPS (2)	Uninterruptible Power Supply	
URL	Uniform Resource Locator	Do not define
USB	Universal Serial Bus	
UTC	Coordinated Universal Time	
UTP	Unshielded Twisted Pair	Do not define
UTP/STP	Unshielded Twisted Pair/Shielded Twisted Pair	Do not define
UVRP	user virtual route process	

V

Acronym	Term	Comments
VAN	value-added network	
VAR	value-added reseller	
VDH	very high density	
VDM	virtual DOS machine	Windows NT Term
VDP	virtual disk process	
VFS	virtual filestore	
VFU	vertical format unit	
VGA	video graphics array	Do not define
VHDCI	Very High-Density Connector Interface	
VHF	very high frequency	
VHS	Virtual Hometerm Subsystem	
VIA	Virtual Interface Architecture	
VIO	video input/output	
VIPL	Virtual Interface Provider Library	
VLAN	virtual LAN	
VLM	virtual loadable module	
VLSI	very large-scale integration	
VM	virtual memory	
VMM	virtual memory manager	
VPN	virtual private network	
VR	virtual route	
VRAM	video RAM	
VRC	vertical redundancy check	
VRM	voltage regulator module	
VS	virtual screen	
VSAM	virtual storage access memory	
VTAM	Virtual Telecommunications Access Method	

W

Acronym	Term	Comments
WACK	wait for acknowledgment	
WAN	wide area network	Do not define
WBEM	Web-Based Enterprise Management	
WINS	Windows Internet Name Service	
WORM	write once, read many	
WSH	workstation handler	
WSL	workstation listener	
WSPTP	workstation process-to-process	
WWW	World Wide Web	

XYZ

Acronym	Term	Comments
XATMI	X/Open Application-Transaction Monitor Interface	
XDR	external data representation	
XIO	extensible I/O	
XLB	extended memory link control block	
XMIOP	extended maintenance I/O process	
XMS	extended memory specification	
XNS	Xerox Network Systems	
XTI	X/Open Transport Interface	
ZIF	zero insertion force	

Setting Up a Remote Print Queue on a Terminal Server

Appendix A

Overview

The correct way to create a remote print queue on a terminal server is to follow a four-step process.

1. Set up the terminal server.
2. Set up the printer port on the server.
3. Set up the application port on the OpenVMS system.
4. Set up the print queue.

Obtaining Printer Information

Printer Test Sheet

Obtain a test sheet from the printer and verify the device setting for:

- Character size
- Parity
- Flow control
- Baud rate

Step 1: Set Up the Terminal Server

Specify a Terminal Server Name

Follow the specific instructions for installing and initializing the terminal server.

Assign a name to the terminal server.

- The name must be unique on the Ethernet.
- The name can be up to six characters long.
- The name must be written to both the permanent and volatile server database.

To set the server name, use local mode.

Format:

```
Local> SET SERVER NAME name
```

For example, to set the server name to ZK1123:

```
Local> SET PRIV
```

```
Local> SET SERVER NAME ZK1123
```

Verify the server name.

```
Local> SHOW SERVER
```

Step 2: Set Up the Printer Port on the Server

Display Port Characteristics

Use the terminal server in local mode to display the characteristics of the port to which the printer is to be connected.

```
Local> SHOW PORT 2 CHARACTERISTICS
```

Port 2:

```
Character Size:      8   Input Speed:      4800
Flow Control:       XON  Output Speed:     4800
Parity:             None  Modem Control:  Disabled
```

```
Access:             Remote  Local Switch:   None
Backwards Switch:   None   Name:         LN03_4
Break:             Disabled Session Limit:   1
Forwards Switch:    None   Type:         Hard
```

Preferred Service: None

Authorized Groups: 0
(Current) Groups: 0

Enabled Characteristics:

Autoconnect, Autoprompt, Inactivity Logout, Internet
Connections,
Line Editor, Password

Set the Printer Port

In local mode on the terminal server, use the commands appropriate to the specific server to set up the printer port.

1. Give the port an appropriate name. For example, to assign the name LN03_4 to port number 2:

```
Local> SET|DEFINE PORT 2 NAME LN03_4
```

2. Modify the port characteristics. Disable all enabled characteristics on the high-end servers and all enabled characteristics on low-end servers except for INPUT FLOW CONTROL and OUTPUT FLOW CONTROL.

```
Local> SET|DEFINE PORT 2 SPEED 4800
```

```
Local> SET|DEFINE PORT 2 AUTOBAUD DISABLE
```

```
Local> SET|DEFINE PORT 2 BROADCAST DISABLE
```

3. Make the changes permanent using the terminal server specific method.

4. Verify the port setting and the server name.

```
Local> SET PRIV
```

```
Local> SHOW SERVER
```

```
Local> SHOW PORT 2
```

5. Test the port. You should see a consistent test pattern.

```
Local> TEST PORT 2 COUNT 20 WIDTH 80
```

Example: Low-End Server

The following example sets up the server port 2 for a 4800 baud printer on a low-end server such as the DECserver 200.

```
Local> DEFINE PORT 2 NAME LN03_4
Local> DEFINE PORT 2 ACCESS REMOTE
Local> DEFINE PORT 2 AUTOBAUD DISABLED
Local> DEFINE PORT 2 SPEED 4800
Local> DEFINE PORT 2 PREFERRED NONE DEDICATED NONE
Local> LOGOUT PORT
```

Example: High-End Server

The following example sets up the server port 2 for a 4800 baud printer on a high-end server such as the DECserver 500.

```
Local> SET PORT 2 NAME LN03_4
Local> SET PORT 2 ACCESS REMOTE
Local> SET PORT 2 AUTOBAUD DISABLED
Local> SET PORT 2 SPEED 4800
Local> SET PORT 2 PREFERRED NONE DEDICATED NONE
Local> SAVE PORT 2
Local> LOGOUT PORT 2
```



Note

Use the Terminal Server Configurator on the DECserver 500 system:

```
TSC>DEFINE PORT 2 SPEED 4800
```

Step 3: Set Up the Application Port on the OpenVMS System

Application Port

You must create an application port and map on each node that will host the remote print queue every time the system is initialized.

The computers that will access the printer must all be located on the same OpenVMS Cluster system.

Application ports are called LTA####, where #### is a number from 1 to 9999.

Each application port name must be unique.

- Design a numbering system to keep the port names unique.
- Before assigning a port name, check to see if it already exists.

Setting Up the Application Port

Perform the following steps on the node that will run the print queue:

1. Run LATCP.
2. Create the port

```
LATCP> CREATE PORT LTA####
```
3. Associate (or map) the application port with the terminal server port.

```
LATCP> SET PORT LTA####:/APPLICATION/NODE=terminal-server-name -  
_LATCP> /PORT=port-name
```
4. Make the changes permanent by adding both commands to the LAT startup command procedure.
 - The LAT startup command procedure should be called from SYSTARTUP_VMS.COM.
 - The call to invoke the LAT startup command procedure should be after the DECnet network is up and running.

Example: Create and Map an Application Port

The following example creates an application port name LTA8000 and maps the application port to the port LN03_4 on terminal server ZK1123.

```
LATCP> CREATE PORT LTA8000: /APPLICATION
```

```
LATCP> SET PORT LTA8000:/APPLICATION/NODE=ZK1123/PORT=LN03_4
```

Verify the Port Mapping

To verify the mapping of the application port to the terminal server port, enter the following command on the node that is to host the remote print queue:

```
$ COPY/LOG filename LTA####:
```

```
$ COPY/LOG filename LTA8000:
```

Step 4: Set Up the Print Queue

Special Steps for Remote Print Queues

Initialize the remote print queue using the same procedures as for regular print queues, with some important differences.

1. Set the printer characteristics.
2. Set protection on the device to allow only the system to access the printer.
3. Set the device spooled.
4. Define forms.
5. Initialize the queue.
6. Start the queue.
7. Test the queue.

Set the Printer Characteristics

A command procedure to be executed at system initialization sets the printer characteristics on each node that will use the queue.

SET TERMINAL Command

Format:

\$ SET TERMINAL application-port-name

Qualifiers:

/PERMANENT	Sets characteristics to survive terminal sessions. Characteristics revert to original values if the system is halted and restarted.
/DEVICE=terminal- type	Specifies the type of terminal and sets characteristics according to the terminal type.
/WIDTH=x	Specifies the maximum characters line. This value must be an integer in the range of 1 to 511 and should be set to the maximum number of characters for all print forms.
/PAGE=y	Specifies the number of print lines perforations for hardcopy terminals. (When the terminal reads a form feed, it advances the paper to the next perforation.) The value of the parameter can be from 0 to 255 and defaults to 0 (which treats a form feed as a line feed).
/NOBROADCAST	Controls whether reception of OpenVMS broadcast messages is enabled. When used with a print queue, stops messages from interrupting the printing of the output file.

Example:

\$ SET TERMINAL/PERMANENT/DEVICE=LN03/NOBROADCAST/PAGE=60 LTA8000:

Set the Device Protection

The application port should only be accessed by the system and not by owner, group, or world.

```
$ SET SECURITY/CLASS=DEVICE/PROTECTION=(S:RWLP,0,G,W) LTA####:
```

The access categories:

R	Can issue read requests to the device
W	Can issue write requests to the device
L	Can issue logical I/O requests to the device
P	Can issue physical I/O requests to the device
Null	No access

Set the Device Spooled

The remote print queue device should be set spooled to prevent applications from sending output directly to the printer.

Format:

```
$ SET DEVICE LTA####:/SPOOLED
```

Initialize the Queue

Create or initialize the queue.

Format:

```
$ INITIALIZE/QUEUE queue-name
```

Special qualifiers to remote print queues:

/PROCESSOR = LATSYM	Specifies that the print symbiont be the one designed specifically for use with the LAT protocol
/AUTOSTART_ON=(node::device,.)	Associates the queue with the application port, which was mapped previously to a particular server and server port
/START	Makes the queue active

You can also use other INITIALIZE qualifiers appropriate for print queues.

Test the Printer

Test the printer setup by printing a file on the printer.

```
$ PRINT/QUEUE=laser myfile.txt
```

