Fragmentation Cost Analysis

User's Guide

October 1994

This document describes the operation of Executive Software International's Fragmentation Cost Analysis.

This document is intended for OpenVMS system managers.

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Operating System: OpenVMS VAX and OpenVMS AXP

Executive Software International, Inc., Glendale, CA

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Preface

Manual Objectives

After reading and understanding this document, the reader should be able to successfully operate the Fragmentation Cost Analysis.

Intended Audience

This manual is intended for OpenVMS™ VAX™ and AXP™ system managers.

Structure of This Document

- Chapter 1 describes how to run the Fragmentation Cost Analysis.

Conventions

The following conventions are used throughout this document:

`Disk:`

In examples, typewriter-style print that is not bold indicates messages and prompts displayed on your screen.

`FCA`

In examples, bold typewriter-style print illustrates characters you type.

`disk_name`

In examples, italic typewriter-style print shows when you should enter or type an appropriate value, but not the exact characters shown.

Return

This describes the carriage return key on the terminal keyboard.

Introduction

Performance loss from fragmentation is costing your company money. Your company is paying for the extra time computer users are waiting for fragmented files. User salaries vary, but a portion of these salaries is being thrown away simply waiting for the computer. Additionally, the cost of the time to perform backup and restore periodically must also be figured in.

After using the Fragmentation Analysis Utility to determine that fragmentation does indeed exist on your system, the Fragmentation Cost Analysis will quickly and easily provide an estimate of how much fragmentation is costing you.

1 FRAGMENTATION COST ANALYSIS OPERATION

The Fragmentation Cost Analysis gathers information about your system and its users, then estimates the cost of fragmentation on your system. It also provides a written analysis showing the estimate of how much fragmentation is costing you.

The Fragmentation Cost Analysis is automatically installed when you install the Fragmentation Analysis Utility.

1.1 Before Running the Fragmentation Cost Analysis

In order to calculate the estimated cost of fragmentation on your system, it is necessary for you to gather information about your system. Specifically, the following factors are good indicators of the effects of fragmentation, and are used by the Fragmentation Cost Analysis in determining the cost of fragmentation on your system:

- Approximate percentage of free disk space
- Amount of CPU idle time
- Average split transfer rate, or number of split I/Os (occasions when the system must read from the disk more than once to satisfy an I/O request)

1.1.1 Determining the Approximate Free Disk Space on your System

The amount of free disk space on your system can impact the effect of fragmentation on your system. Systems with little free space are slowed by fragmentation to a greater degree than those with ample free space.

One of the questions asked by the Fragmentation Cost Analysis is in regards to the approximate percentage of free disk space on your systems. Many Data Center Managers already have a good idea of this percentage, but if you do not, perform the following steps on the most heavily-used disks on your system to get an approximate figure:

1 Issue this command at the DCL ($) prompt, where *device_name* is the name of a heavily-used disk device on your system:

```
$ SHOW DEVICES /FULL device_name
```

This will cause a display similar to the one shown in Figure 1–1:

Figure 1–1 Sample SHOW DEVICES Output

```
Disk BOOT$DKA200:, device type RZ23, is online, mounted, file-oriented device,
    shareable, available to cluster, error logging is enabled.
    Error count                    0    Operations completed            126176
    Owner process                 ""    Owner UIC                      [SYSTEM]
    Owner process ID        00000000    Dev Prot    S:RWED,O:RWED,G:RWED,W:RWED
    Reference count                1    Default buffer size                512
    Total blocks              204864    Sectors per track                   33
    Total cylinders              776    Tracks per cylinder                  8
    Host name                 "BOOT"    Host type, avail   VAXstation 3100, yes

    Volume label           "USERDISK"    Relative volume number               0
    Cluster size                   3    Transaction count                    1
    Free blocks                25269    Maximum files allowed            25608
    Extend quantity                5    Mount count                          6
    Mount status              System    Cache name        "_$4$DKA700:XQPCACHE"
    Extent cache size             64    Maximum blocks in extent cache     2526
    File ID cache size            64    Blocks currently in extent cache      0
    Quota cache size               0    Maximum buffers in FCP cache        305

  Volume status:  subject to mount verification, file high-water marking, write-
      through caching enabled.

$
```

2 Divide number of free blocks by the total number of blocks, and multiply the result by 100. In the example shown above, the calculation would be:

```
(25269 / 204864) * 100 = 12.33%
```

Since the Fragmentation Cost Analysis prompts you to estimate how *full* your disks are, subtract the percentage calculated in the formula above from 100 (i.e. 100 - 12.33 = 87.67% full).

Note that this calculation does not take into account blocks of space in the extent cache, but the figure it produces will suffice for the purpose of the Fragmentation Cost Analysis.

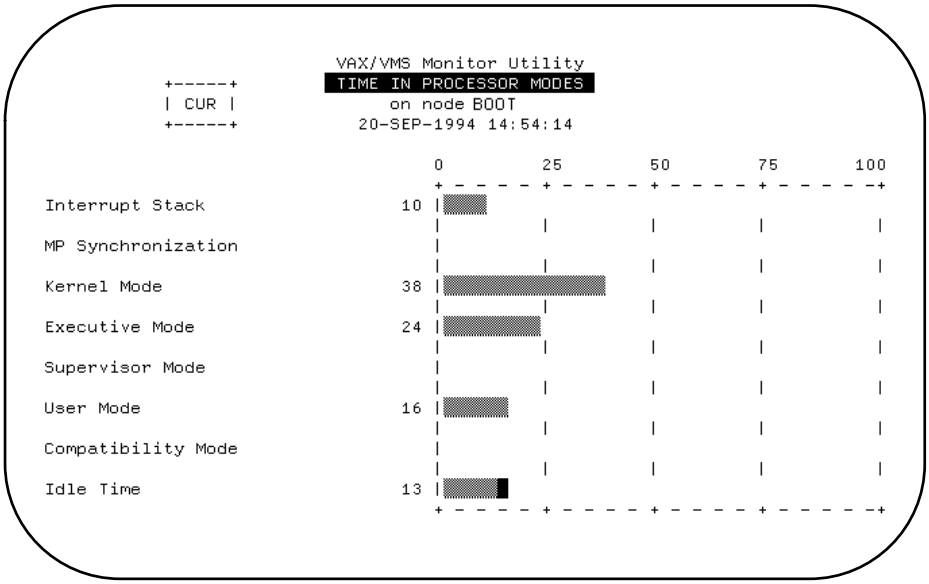
1.1.2 Determining the CPU Idle Time on your System

The amount of CPU idle time available on your system can be affected by the fragmentation of files on your disks. A heavily fragmented system consumes Kernel Mode time due to the increased number of disk I/Os. This, in turn, reduces the amount of available CPU idle time. To determine the amount of CPU idle time available on your system, enter this command at the DCL ($) prompt at a time when your system is being heavily used:

```
$ MONITOR MODES
```

This will cause a graph similar to the one shown in Figure 1–2 to be displayed:

Figure 1–2 Sample MONITOR MODES Output



Observe the bottom line of the graph during a peak period of the day and note the range in which it fluctuates. This information will be used when you run the Fragmentation Cost Analysis.

1.1.3 Determining the Split Transfer Rate on your System

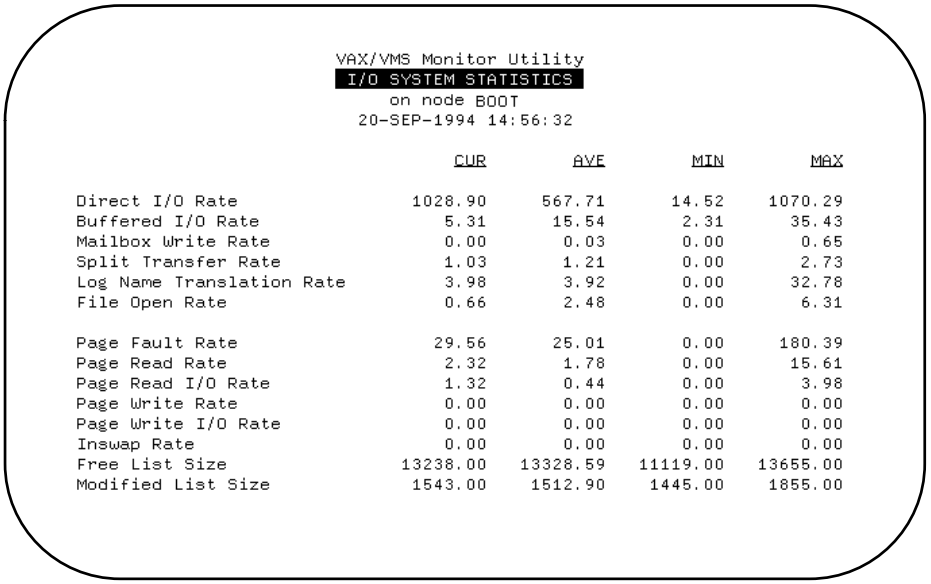
The split transfer rate (or split I/O count) indicates the number of I/O operations that have been split into two or more I/O operations to retrieve data that is in two or more fragments of a file. This is the most meaningful indicator of the actual cost of fragmentation on your system.

To determine the split transfer rate on your system, enter this command at the DCL ($) prompt at a time when your system is being heavily used:

```
$ MONITOR IO
```

This will cause a table similar to the one shown in Figure 1–3 to be displayed:

Figure 1–3 Sample MONITOR IO Output



VAX/VMS Monitor Utility
I/O SYSTEM STATISTICS
on node BOOT
20-SEP-1994 14:56:32

	CUR	AVE	MIN	MAX
Direct I/O Rate	1028.90	567.71	14.52	1070.29
Buffered I/O Rate	5.31	15.54	2.31	35.43
Mailbox Write Rate	0.00	0.03	0.00	0.65
Split Transfer Rate	1.03	1.21	0.00	2.73
Log Name Translation Rate	3.98	3.92	0.00	32.78
File Open Rate	0.66	2.48	0.00	6.31
Page Fault Rate	29.56	25.01	0.00	180.39
Page Read Rate	2.32	1.78	0.00	15.61
Page Read I/O Rate	1.32	0.44	0.00	3.98
Page Write Rate	0.00	0.00	0.00	0.00
Page Write I/O Rate	0.00	0.00	0.00	0.00
Inswap Rate	0.00	0.00	0.00	0.00
Free List Size	13238.00	13328.59	11119.00	13655.00
Modified List Size	1543.00	1512.90	1445.00	1855.00

The figures in the table reflect data gathered starting at the time you issue the MONITOR command. For this reason, you should allow the display to run for a period of time, at least several minutes. This ensures the information gathered is representative of your system's workload.

The fourth line shows the split transfer rate. Note the figure shown in the "AVE" (for average) column after the display has run during a peak period of the day. This information will be used when you run the Fragmentation Cost Analysis.

1.2 Defining a Symbol for the Fragmentation Cost Analysis

For ease of use, define the following symbol in the system-wide login procedure or the individual login procedures of the users needing access to the Fragmentation Cost Analysis:

```
$ FCA == "@device_name:[directory]FCA.COM"
```

where *device_name*:[*directory*] is the device and directory where the FCA.COM command procedure was installed during the installation procedure.

1.3 Running the Fragmentation Cost Analysis

Once the **FCA** symbol has been defined, run the Fragmentation Cost Analysis by entering this command at the DCL ($) prompt:

```
$ FCA
```

This starts a series of screens and prompts where you will answer the following sequence of questions:

- Your company name
- Your first and last name
- How full your disks are
- How much CPU idle time your system has
- The average Split Transfer rate (split I/Os) on your system
- What your computer is primarily used for (one or more of these choices):
  - » Backup or redundant system
  - » Research and Development
  - » Running inventory control or production control applications
  - » Running word processing, text editing, or electronic mail
  - » Running databases that use pre-allocated disk space
  - » Running CAD/CAM applications
  - » Compiling or executing FORTRAN/Ada/BASIC or other languages
  - » Running databases that do NOT use pre-allocated disk space
- How many hours per day your computer is being used with users logged in
- Whether your system is part of a computer cluster
- The approximate cost of your computer system
- What is the expected payback period for of your computer system in months
- The number of 8-hour shifts worked at your site
- Your monthly cost of hardware maintenance and software update service
- The number and average salaries of the following computer operations personnel:
  - » Computer Operators
  - » System Managers
  - » Programmers
  - » Database Administrators
  - » MIS Directors
- The number and average salaries of the following full and part time computer users:
  - » Clerical personnel
  - » Sales personnel
  - » Management personnel

» Research/Scientific personnel

After the data has been gathered, the Fragmentation Cost Analysis creates a text file named FCA_REPORT.RPT located in the directory from where the Fragmentation Cost Analysis was invoked.

As an option, the Fragmentation Cost Analysis can also send you (via the OpenVMS MAIL utility) a copy of the FCA_REPORT.RPT file.

The FCA_REPORT.RPT file is a comprehensive report showing the information you have input, as well as the calculations used to determine the estimated cost of fragmentation on your system. This report also shows:

- Estimated monthly system costs lost due to fragmentation
- Estimated monthly computer personnel salary costs wasted due to fragmentation
- Estimated monthly user salary lost due to fragmentation
- Total estimated monthly fragmentation-related costs and losses

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