



OpenVMS Utilities update

1G02

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Agenda

- V8.2 new features (short review)
- V8.3 new features
- Latest happenings with OpenVMS BACKUP

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Agenda

- V8.2 new features (short review)
 - DCL Extended token support
 - New DCL commands, extensions, lexical functions
 - MONITOR
 - System Service Logging
- V8.3 new features
- Latest happenings with OpenVMS BACKUP

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DCL Extended token support

- DCL increased the token size from 255 bytes to 4000 bytes
- Extended tokens allow file specifications >255 characters
- DCL has been modified to support long file names
- token size controlled by:
 - `SYSGEN` parameter `DCL_CTLFLAGS` (system)
 - `SET PROCESS/TOKEN=[EXTENDED | TRADITIONAL]` (process)
- Extended token size is disabled by default

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DCL commands, extensions, logicals...



- New Lexical functions
 - F\$LICENSE
 - F\$FID_TO_NAME
- SHOW SYSTEM/IMAGE
- DIRECTORY/SELECT=VERSION=[MIN|MAX]
- SHOW FASTPATH
- CREATE & DELETE/MAILBOX
- DELETE & PURGE/GRAND
- WRITE/NOWAIT, OPEN/NOSHARE
- new qualifiers for SEARCH: /SKIP, /LIMIT, /WILD
- new qualifier for ASSIGN, DEASSIGN, DEFINE: /CLUSTER
- More B2B support ("Blocks to Bytes")
- progress indicator for COPY/DELETE/PURGE (CTRL-T AST)

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MONITOR changes



Did you know, that...

- MONITOR was written in VAX PL/I
- MONITOR is a vested image on OpenVMS Alpha
- too many users of MONITOR can impact system performance

In V8.2...

- VAX PL/I code has been rewritten in C
- Various performance enhancements made
- Bugfixes (Average>Max, values >100%)
- CUR display for MONITOR SYSTEM added
- Data record format changed -> MONITOR_CONVERT converts new MONITOR data files to pre-V8.2 format

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System Service Logging...

- Mechanism to record information about system service activity for:
 - Exec and kernel mode services
 - a specific process
- main goal is to aid in troubleshooting
- Information that gets recorded
 - Service identification, Caller/Access mode of caller, image and offset, Arguments, Time stamp, Completion status, etc.
- Starting SS logging
 - `SYSSER_LOGGING = 1`
 - `SET PROC/SSLOG=(START=ON,...)`

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...System Service Logging...

- Display logged information via DCL command `ANALYZE/SSLOG <file>`
- `ANALYZE/SSLOG` allows filtering the report by
 - Access mode
 - Completion status
 - System service name
 - Image name

```

$> TYPE ssl.com
$ inner=0
$ define sys$output nla0:
$ loop1:
$   write sys$output f$fid("sys$sysdevice","(9232,24,0)")
$   dloop=F$FAO("Inner loop count is !SL !/",inner)
$   if inner .lt. 2000 then goto loop1
$   deassign sys$output
$   exit

```

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ANALYZE / SSLOG / STAT

START version: 1.1 process: 26800426 ABC !24-NOV-2004 12:43:52.54
 username: ABC node: XXX platform: IA64
 buffer count: 6 size: 65024 start_flags: 00000003

Service	Count	User	Super	Exec	Kernel	Rate/sec
SY\$RMS_GET	185874	0	185874	0	0	939.7
SY\$ENQ	111680	0	0	1	111679	564.6
SY\$DEQ	109722	0	0	1	109721	554.7
SY\$QIO	76406	0	36996	36622	2788	386.3
SY\$RMS_FIND	37180	0	37180	0	0	188.0
SY\$PERSONA_EXT_LOOKUP	37146	0	0	0	37146	187.8
SY\$GETDVI	37018	0	37000	18	0	187.1
SY\$ASSIGN_LOCAL	36970	0	36952	18	0	186.9
SY\$FILES SCAN	36856	0	36856	0	0	186.3
SY\$CLRAST_INTERNAL	36837	0	0	36837	0	186.2
SY\$DASSGN	36801	0	36778	10	13	186.1
SY\$TRNLNM	36765	0	36699	66	0	185.9
SY\$DCLAST	36729	0	0	36729	0	185.7
SY\$RMS_PUT	36669	0	36669	0	0	185.4
SY\$SYNCH_INT	326	0	326	0	0	1.6
SY\$CRMPSC_FILE_64	32	0	0	32	0	0.2
SY\$MGBLSC_64	25	0	0	25	0	0.1
SY\$CMKRNL	18	0	0	18	0	0.1
SY\$SETPRT_64	12	0	0	12	0	0.1

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Agenda

- V8.2 new features (short review)
- V8.3 new features
 - Customizing CTRL-T output, Remote CTRL-T
 - Symbolic link support
 - DCL symbols, SHOW PROCESS, COPY, DIFFERENCES, lexicals, SEARCH, DIR, MONITOR, Queue Manager, SPAWN, SYNCH, DCL prompt, READ...
- Latest happenings with OpenVMS BACKUP

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Customizing CTRL-T output...

- The output of the CTRL-T message may be customized
- The contents of the symbol DCL\$CTRLT will be appended to the traditional CTRL-T output
 - Useable from applications and DCL
 - May be used for debugging applications
 - Display name of the procedure currently being executed by DCL
- Like every symbol, DCL\$CTRLT may have different values in different procedure levels

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```
$> type ctrlt_looper.com
```

```
$ inner = 0
$ outer = 0
$ loop:
$ loop1:
$ if inner .gt. 20000 then goto end_loop1
$ inner = inner+1
$ dcl$ctrlt=F$FAO("Inner loop count: !SL !/ Outer loop count: !SL",inner,outer)
$ goto loop1
$ end_loop1:
$ inner = 0
$ outer = outer+1
$ goto loop
```

```
$> @ctrlt_looper
```


```
MYNODE::ME 10:46:37 (DCL) CPU=00:03:42.68 PF=13453 IO=6743 MEM=187
Inner loop count: 12306
Outer loop count: 0
MYNODE::ME 10:46:43 (DCL) CPU=00:03:49.19 PF=13455 IO=6744 MEM=187
Inner loop count: 19200
Outer loop count: 2
```

Simple DCL procedure demonstrating
customizing CTRL-T output

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```

$> type ctrlt_looper.c
#include <descrip>
void main() {
int counter = 0;
$DESCRIPTOR(sym_name, "dcl$ctrlt");
static struct dsc$descriptor_s value_desc;
char buffer[256] = {0};
value_desc.dsc$b_dtype = DSC$K_DTYPE_T;
value_desc.dsc$b_class = DSC$K_CLASS_S;
while (1) {
counter++;
sprintf(buffer,"Counter is %d",counter);
value_desc.dsc$a_pointer = buffer;
value_desc.dsc$w_length = strlen(buffer);
lib$set_symbol(&sym_name,&value_desc);
}
}
$> run ctrlt_looper
MYNODE::ME 10:47:27 CTRLT_LOO CPU=00:03:53.26 PF=13631 IO=6784 MEM=335
Counter is 216766
MYNODE::ME 10:47:28 CTRLT_LOO CPU=00:03:54.45 PF=13631 IO=6785 MEM=335
Counter is 338429

```

Simple C program demonstrating customizing CTRL-T output

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...Customizing CTRL-T output

Displaying the name of the current procedure

```

$ if f$trnlnm("DCL$CTRLT_DEBUG") .NES. ""
$ then
$   dcl$ctrlt =
$     f$parse(f$environment("procedure"),,, "NAME")+ -
$     f$parse(f$environment("procedure"),,, "TYPE")
$ endif

```

- With V8.3, when SYS\$OUTPUT is redirected, CTRL-T output will still be displayed on the terminal.

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Remote CTRL-T...

- Introducing the concept of remote CTRL-T
 - CTRL-T can display standard CTRL-T information about remote processes.
 - “Remote” is defined as “a different system within the cluster”
 - The symbol `DCL$CTRLT_PID` should contain the PID of the remote process

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...Remote CTRL-T

```

$! Running on node NODE01....hitting CTRL-T
$
NODE01::ME 17:40:55 (DCL) CPU=00:00:00.16 PF=212 IO=98 MEM=146
$
$! Now define the new symbol
$!
$ DCL$CTRLT_PID="23800436"
$
$! Hit CTRL-T again
$!
NODE02::YOU 17:41:12 LOOPER CPU=01:28:05.17 PF=2700 IO=594 MEM=322
$
NODE02::YOU 17:41:14 LOOPER CPU=01:28:07.02 PF=2700 IO=594 MEM=322
$

```

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Symbolic link support...

- **CREATE/SYMLINK**
 - `crea/sym="/vms$common/sysexe/dcl.exe" dcl_link.txt`
- **SET/SHOW ROOT [/SYSTEM|PROCESS]**
- **SET DEFAULT** now supports POSIX pathnames
 - \$ `set def "^UP^/sys0/syslib"`
- **New lexical functions**
 - **F\$READLINK**
 - **F\$SYMLINK_ATTRIBUTES**

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...Symbolic link support

- **DIRECTORY**
 - `DIR/FULL` displays the link contents
 - If any file attribute requested, the contents of the link is also displayed

```
$> DIR/DATE
Directory $1$DKC600:[TOPAZ.SYMLINK_TEST]
A.A;1                24-NOV-2004 14:26:34.07
B.B;1                24-NOV-2004 14:26:36.46
LINK.TXT;1 -> /login.com 16-OCT-2004 18:20:28.13
Z.Z;1                24-NOV-2004 14:26:39.90
```

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New permanent DCL symbols

- On image rundown DCL populates `$SEVERITY` and `$STATUS`
- With V8.3, `$FACILITY` and `$IDENT` have been added

```
$ exit %x10911a02
$ show symbol $status
  $STATUS == "%X10911A02"
$ show symbol $facility
  $FACILITY == "%X00000091"
$ show symbol $ident
  $IDENT == "%X00000340"
$ show symbol $severity
  $SEVERITY == "2"
$
```

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SHOW PROCESS



- `SHOW PROCESS/CONTINUOUS` now supports the 'Q' option
- 'Q' = Quota
- While the continuous display is running, it is now possible to hit 'Q' and dynamically monitor the process quotas

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```

PowerTerm 420/32 - TELNET
File Edit Terminal Communication Options Macro Script Help
VT420-7 24:1 Eng Case Hold On Line

Process C:\MSERVR 09:23:05

State LEF Working set 6223
PID 00000453 Page faults 5681
UIC [SYSTEM] Event flags C0000001
80000000

# open files remaining 119/128 ( 92%)
Direct I/O count/limit 100/100 (100%)
Buffered I/O count/limit 99/100 ( 99%)
BUFIO byte count/limit 250816/250816 (100%)
ASTs remaining 98/100 ( 98%)
Timer entries remaining 15/16 ( 93%)
P6FL quota count/limit 39671/43750 ( 90%)
ENQ quota count/limit 2048/2048 (100%)

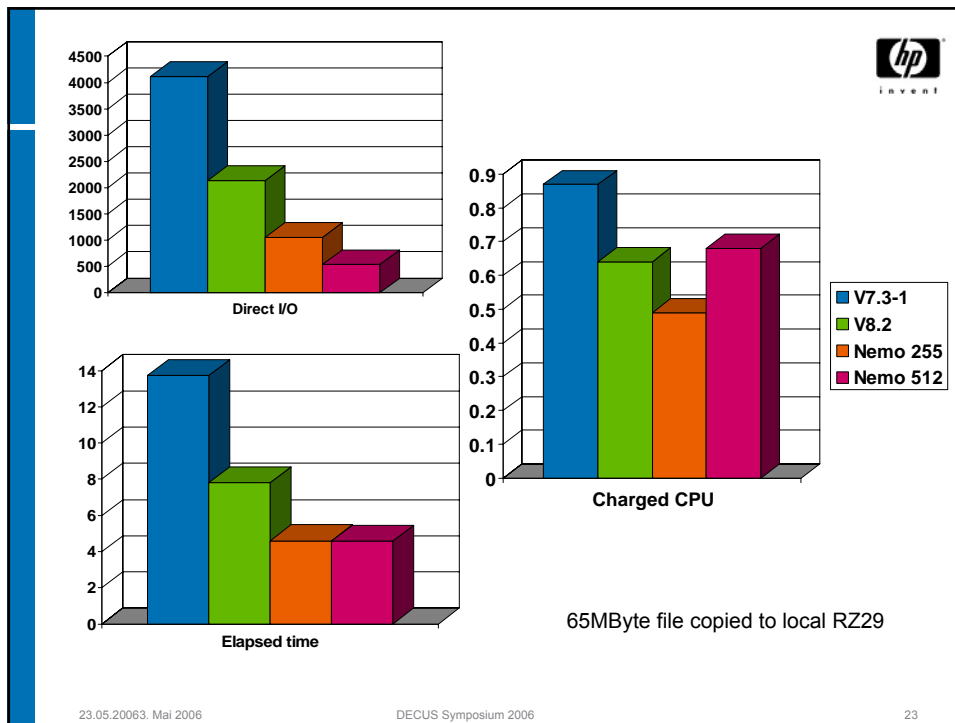
UHS2$DKR600: [SYS0.SYSCOMMON.] [UBEN_SERVICES] C:\MSERVR.EXE:2

```

COPY and data transfer sizes



- Pre-V7.3-2: I/O size is 64 blocks
- V7.3-2: I/O size is 127 blocks
- V8.2 added the `/BLOCK_SIZE` qualifier
 - Default I/O size is 124 blocks
 - Maximum I/O size is 127 blocks
- V8.3 removes the I/O size limit
 - Copy has been modified to use 64bit RMS extensions
 - Can't exceed maximum I/O size supported by the port driver
 - Asynchronous I/O will improve performance even more (..but we have to leave something for the next release)



DIFFERENCES

- `DIFF/IGNORE=SPACE` compresses multiple spaces and tabs down to one space before comparing
- `/IGNORE=WHITE_SPACE` removes all spaces and tabs before comparing
- In `F$EDIT` terminology, `COMPRESS` VERSUS `COLLAPSE`
- Very useful when looking at code written by different people with different coding preferences

```
status = routine(a,b,c)
vs.
status = routine (a,b,c)
```



Lexical Functions...

- **F\$LICENSE** now supports 3rd party producers
 - Optional producer argument has been added, DEC/HP assumed if omitted.

```
$ write sys$output f$license("PLI","KEDNOS")
TRUE
```

- **F\$CUNITS** – New lexical function
 - **F\$CUNITS** (number to convert, from_units, to_units)
 - The first argument is limited to 32 bits
 - Currently only knows how to convert blocks to bytes
 - What else do you need?

```
$ write sys$output f$cunits(4432216,"blocks","bytes")
2.11GB
```

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...Lexical Functions

- **F\$MATCH_WILD**
 - Performs wildcard matching between candidate and pattern string
 - Returns **TRUE** if the strings match
 - Syntax

- **F\$MATCH_WILD(CANDIDATE, PATTERN)**

```
$ write sys$output -
_ $ f$match_wild("This is a candidate","*c%d*")
TRUE
$
```

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SEARCH

- `SEARCH/STATISTICS` now defines several DCL symbols with statistics information

```
Files searched:          125   Buffered I/O count: 602
Records searched:      15575  Direct I/O count:   135
Characters searched:  842598  Page faults:        36
Records matched:       45     Elapsed CPU time: 00.26
Lines printed:         97     Elapsed time:       02.87
```

```
$ sh sym search*
SEARCH$CHARACTERS_SEARCHED = "842598"
SEARCH$FILES_SEARCHED     = "125"
SEARCH$LINES_PRINTED      = "97"
SEARCH$RECORDS_MATCHED    = "45"
SEARCH$RECORDS_SEARCHED   = "15575"
```

- `$ SEARCH/WILDCARD_MATCHING=[RELAX | STRICT]`

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DIRECTORY & MAGTAPES

★ To DIRECTORY... all blocks are treated equal ☺

```
$ dir mkb100:[000000]/size
```

```
Directory MKB100:[]
```

```
TEST1.BCK;1          619KB
TEST2.BCK;1          619KB
TEST3.BCK;1           74KB
```

```
Total of 4 files, 1.78MB
```

Old

```
$ dir mkb100:[000000]/size
```

```
Directory MKB100:[]
```

```
TEST1.BCK;1          9.67MB
TEST2.BCK;1          9.67MB
TEST3.BCK;1          9.17MB
```

```
Total of 4 files, 36.65MB
```

New

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MONITOR

- New “TOP” display
 - Top processes that use Kernel, Exec, Super or User mode on the system
 - `MONITOR PROCESS / [TOPKERNEL | TOPEXEC...]`
- **Align** class added to monitor alignment fault rate

OpenVMS Monitor Utility
ALIGNMENT FAULT STATISTICS
on node MYNODE
3-JAN-2006 15:32:59.66

	CUR	AVE	MIN	MAX
Kernel Alignment Faults	1655.00	1613.00	1356.00	2068.00
Exec Alignment Faults	8525.00	8657.79	7499.00	10527.00
Super Alignment Faults	0.00	0.00	0.00	0.00
User Alignment Faults	1294.00	1267.20	1084.00	1628.00
Total Alignment Faults	11474.00	11538.00	10011.00	14223.00

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Queue Manager

- Increased batch queue job limit to 65535 (was 255)
 - Will be available on V7.3-2 as the infrastructure is already available
 - The front end of the batch interface was forcing the limit of 255 jobs
- Performance enhancement to `SYS$SNDJBC`
 - Avoid heavy alignment faults (2000 faults per submit)
 - Pad the message being exchanged between the job controller and the Queue manager
 - The old algorithm is used when Queue Manager is running on a pre-V8.3 node
 - In mixed version clusters, run the Queue Manager on a V8.3 node for optimal performance!

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65535 SPAWNED processes

- Maximum number of spawned subprocesses increased to 65535
- Previous limit was 255
 - When this limit is reached - excessive CPU time (with spinlocks held) trying (and failing) to create more processes
- Numeric portion of the spawned process name increased from byte to word
 - **Username portion may be truncated from 11 to 9 characters**
 - Set bit 2 in `DCL_CTLFLAGS` to restore previous behavior (255 spawned processes)
 - `%DCL-S-SPAWNED, process THILO_47132 spawned`

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General Enhancements...

- **SYNCHRONIZE/TIME_OUT**
 - Allows specifying the number of seconds to wait before terminating the SYNCH command
- ```

MYNODE> submit looper
Job LOOPER (queue SYS$BATCH, entry 4) started on SYS$BATCH
MYNODE> synch/entry=4/time_out=5
%QUEMAN-W-TMOEXP, timeout period expired

```
- New common qualifier keyword **/SINCE=JOB\_LOGIN**
    - JOB\_LOGIN is the login time of the master process in the job
    - PIPE creates a subprocess for each pipe segment therefore **/SINCE=LOGIN** can't be used in a PIPE

```

MYNODE> pipe dir/since=login | search sys$input test
%SEARCH-I-NOMATCHES, no strings matched
MYNODE> pipe dir/since=job_login | search sys$input test
TEST.TXT;1

```

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## ...General Enhancements...

- **Assure SET LOGIN/INTERACTIVE succeeds during startup**
  - No response from the console
  - No response for an interactive login attempt
  - Typically occurs when `VMS$BASEENVIRON-050_VMS.COM` terminated unexpectedly
- **DEASSIGN/NOLOG**
  - The completion status will be set to success even if the logical name does not exist (instead of %SYSTEM-F-NOLOG)
  - No output is being displayed
- **Performance enhancement to SHOW DEVICE**

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## ...General Enhancements...

- **READ/WAIT**
  - Wait if the record is currently locked by another stream
  - may be combined with `/TIME_OUT`
- **READ/KEY/MATCH={LT|LE}**
  - **READ/KEY** only supports finding matching records with value equal (EQ), greater (GT), or greater or equal (GE) than a key
  - The new keywords add support for finding matching records with value less (LT) or less equal (LE) than a key

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## ...General Enhancements

- **ANALYZE/MEDIA/EXERCISE**
  - Easy way for erasing media (pattern may be specified)
  - Default I/O size increased to 256 blocks
  - Cut the number of I/Os in half
  
- **ANALYZE/SSLOG**
  - Support has been added for selecting entries based on CPU, kernel thread and pthread IDs.
  
- Maximum size of the DCL prompt has been increased to 64 characters (was 32)
  - Allows fancier prompts using escape sequences

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## Agenda

- V8.2 new features (short review)
- V8.3 new features
- Latest happenings with OpenVMS BACKUP
  - DVE
  - Encryption
  - backup\$\_operspec
  - Disk Queue Load
  - Improved CTRL-T message
  - Progress reports
  - Misc. updates



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## BACKUP & DVE

- OpenVMS V7.3-2 added Dynamic Volume Expansion (DVE) support
- Two new terms introduced: Logical Volume size and Expansion Volume size
- Controlled by the `/SIZE` & `/LIMIT` qualifiers to the `INITIALIZE` & `SET VOLUME` commands

|                            |                |                             |                     |
|----------------------------|----------------|-----------------------------|---------------------|
| Error count                | 0              | Operations completed        | 8936                |
| Owner process              | "SYSTEM"       | Owner UIC                   | [SYSTEM]            |
| Owner process ID           | 2817CDDC       | Dev Prot                    | S:RWPL,O:RWPL,G:R,W |
| Reference count            | 2              | Default buffer size         | 512                 |
| Current preferred CPU Id   | 0              | Fastpath                    | 1                   |
| <b>Total size</b>          | <b>33.91GB</b> | Sectors per track           | 96                  |
| Total cylinders            | 7719           | Tracks per cylinder         | 96                  |
| <b>Logical Volume Size</b> | <b>2.38GB</b>  | <b>Expansion Size Limit</b> | <b>190.96GB</b>     |
| Allocation class           | 5              |                             |                     |

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## BACKUP & DVE

- BACKUP had no knowledge about DVE
  - DVE characteristics of a device were lost when image backup performed
- Customers had to manually set DVE characteristics
- BACKUP now fully supports DVE
  - Will ship with next set of BACKUP ECOs

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## BACKUP & DVE – Expansion size

- The volume expansion size is being recorded in the save-set header
- **BACKUP/LIST** displays the expansion size if it exists in the save-set
- When restoring a save-set (using **/IMAGE**) or performing disk-to-disk image backups, the target inherits the expansion size limit of the source
- New qualifiers
  - **/IGNORE=LIMIT** don't inherit the expansion size from source
  - **/LIMIT=n** override the expansion size stored in the save-set header

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## BACKUP & DVE – Logical size

- By default, target logical size is not preserved
  - Restoring image backup of 4GB disk to a 36GB disk will only result in 4GB of usable disk space
- **BACKUP/SIZE**
  - Instructs BACKUP to preserve the target logical volume size
- **BACKUP/SIZE=n**
  - Instructs BACKUP to initialize the target device to have a logical volume size of n

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## BACKUP & DVE – the fine prints

- Did you know....
  - BACKUP/NOINIT initializes the target device...
    - Yes this is not a mistake!
- DVE characteristics will not be preserved if /NOINIT is specified
  - The target device is mounted foreign and we can't retrieve the logical volume size and the expansion size
    - Use /LIMIT & /SIZE if you must

```
MYNODE> backup IA64:[KITS]I64XB3X.BCK/sav dka100:/image/noinit
%BACKUP-I-LOGNOTPRES, logical volume size of volume DKA100: not preserved
%BACKUP-I-LIMITNOTPRES, expansion size limit of volume DKA100: not preserved
```

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## BACKUP\$\_OPERSPEC

- When BACKUP requires the operator's intervention BACKUP\$\_OPERSPEC message is sent to OPCOM.
- With several jobs running in parallel, it is not trivial identifying the job that made the request.
- BACKUP\$\_OPERSPEC has been modified to include process identification and target backup device

```
%%%%%%%%%% OPCOM 27-JUN-2005 07:55:30.46 %%%%%%%%%%%
Request 13, from user SYSTEM on MYNODE
%BACKUP-I-OPERSPEC, specify option (QUIT or CONTINUE)
Requesting PID:00002B8, Target Device:_1DKB600
```

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## Encryption support

- Starting with OpenVMS V8.2 the Encrypt product is covered by the base O/S license
  - No separate license required
- Starting with V8.3 the Encrypt product is integrated into the base O/S
  - No separate installation required
- BACKUP supports creating encrypted save-sets using the `/ENCRYPT` qualifier

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## Encryption support

- How does it work?
  - At run-time, BACKUP generates a random encryption key used for encrypting the save-set records
    - Random (time based) string is XORed with the user's command and encrypted against itself
  - The encryption key is being encrypted using a user provided key and stored in the save-set header
  - Decryption – the encryption key is retrieved by decrypting the key stored in the header using the user provided key

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## Encryption support

- Existing limitations
  - Uses DESCBC algorithm (old, slow & expensive)
  - User provided algorithm is only used for encrypting the key
    - DESCBC is still used for encrypting the data
- V8.3 adds AES encryption support to BACKUP
  - Much faster, modern & stronger encryption
  - User provided algorithm is used for encrypting the data
  - DESCBC is still used by default (to maintain backward compatibility)
  - The following algorithms supported by BACKUP:
    - AESCBC128, AESCBC192, AESCBC256, AESECB, AESCFB and AESOFB

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## Encryption support - examples

- Create an encrypted save-set, specify the encryption key at run-time

```
$ backup *.com coms.bck/sav/encrypt=alg=aes
```

Enter key value:

Verification:

- Create an encrypted save-set, create the encryption key from DCL

```
$ encrypt/create_key THILO "This is a nice key called Thilo"/aes
```

```
$ backup *.com coms.bck/save/encrypt=(alg=aes,name=THILO)
```

```
$ backup coms.bck/save [...] /encrypt=(alg=aes,name=THILO)
```

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## Improved CTRL-T information

- Traditional CTRL-T information showed the name of the current file and the total number of save-set block processed

```
$ backup I64XB37.BCK/save 5dka100:/image
MYNODE::SYSTEM: 14:36:38 BACKUP CPU=00:00:00.86 PF=908 IO=2192 MEM=256
Restoring file: 5DKA100:[DWMOTIF_SUPPORT_I64XB37.KIT]HP.PCSI$COMPRESSED;1
Saveset volume:1, saveset block:720 (32256 byte blocks)
```



```
22.14MB restored out of 1.18GB, 1% completed
Restore rate: 965KB/sec, estimated completion time: 15:07:31.85
```

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## Improved CTRL-T information

- Note the message says ESTIMATED!!!
- Fancy CTRL-T message displayed when
  - Restoring a save-set
  - Creating an image backup of a disk
    - This is really an estimate as files may be marked no backup
- When the amount of data to be saved is unknown, we only display the rate and total amount of data processed so far

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## BACKUP / PROGRESS\_REPORT=n

- CTRL-T can not be used in batch... and BACKUP is usually running in batch...
- /PROGRESS\_REPORT writes CTRL-T style message to the output device every given interval
- n is the number of seconds between intervals

```
$ back I64XB37.BCK/save dka100:/image/progress=10
%BACKUP-I-PROGRESS, progress report generated at 4-JAN-2006 15:00:54.47
Restoring file: DKA100:[DWMOTIF_SUPPORT_I64XB37.KIT]HP1.PCSI$COMPRESSED;1
Saveset volume:1, saveset block:170 (32256 byte blocks)
5.22MB restored out of 1.18GB, 0% completed
Restore rate: 535KB/sec, estimated completion time: 15:39:28.28
```

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## Misc. updates

- **BACKUP STARTVERIFY, STARTRECORD and STARTDELETE** messages modified to include the current time

```
%BACKUP-I-STARTVERIFY, starting verification pass at 4-JAN-2006 15:13:19.88
```

- When performing image backup of 18GB disk, VAX BACKUP will fail to generate a valid boot block on the target device
  - Occurs when VMB.EXE lives on LBN 16777216 (or higher)
  - Fix is available

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## Disk Queue Load

- BACKUP uses a large buffer pool to read file data in an optimized manner
- Algorithm was designed 20 years ago
- All reads for the entire buffer pool are issued concurrently
- Over time buffer pools have gotten larger & the I/O subsystem's tolerance of being flooded with large number of I/Os has decreased
  - Especially true with EVA & XP storage controllers

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## Impact of **DIOLM** on Storage Arrays

- Customer's production environment experienced:
  - Poor performance during BACKUP jobs
  - Using latest EVA VCS, Drive and HBA firmware
  - Using recommended **DIOLM** values of 100
- Recommended: drop **DIOLM** to only 8
  - After system startup
  - Set **DIOLM** on the BACKUP account to 8
  - Before BACKUP jobs, set **PQL\_MDIOLM** to 8
  - After BACKUP jobs, return **PQL\_MDIOLM** to 100
- Performance better by an order of magnitude!!

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## Disk Queue Load

- We had to do something... we re-designed the read algorithm
- **Old behavior**
  - issued as much I/Os possible as allowed by **DIOLM**
  - Continue issuing I/Os until we hit **SS\$\_EXQUOTA**
  - Wait for I/Os to complete and flood the I/O subsystem again
- **The New algorithm**
  - Issue the disk reads in AST threads
  - The completion AST of each thread issues the next I/O
  - By default use 8 parallel I/O threads
  - Number of threads controlled by new **/IO\_LOAD** qualifier

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