Enhancements SDA & Bugcheck in OpenVMS Alpha V7.1

Presentation to OpenVMS
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SDA/Bugcheck goals for Gryphon

- **Dump off system disk**

  ... done

- **Support systems with over 4GB memory**

  ... done

- **Improve resilience**

  ... done

- **Respond to need for minor enhancements**

  ... many done

- **Use of DEBUG semantics**

  ... not done

Dump Off System Disk

- Championed by Clair Grant
- Designed and developed by Ellen Batbouta

- Requirements:
  - Environment variable DUMP_DEV specifies device(s)
  - SYSGEN parameter DUMPSTYLE: bit 2 set
  - MODPARAMS.DAT should include DUMPFILE_DEVICE = <dev>
  - Local disk, [SYSn.SYSEXE]SYSDUMP.DMP
  - ODS2, not shadowed, not in volume set
  - Several VAX restrictions don't apply on Alpha

- DEC 3000 systems:
  - Console at V6.0 or later
  - DUMP_DEV setting not preserved across power failures
  - Can only be reset by power-cycling

- DUMP_DEV also used for system disk failover

Systems over 4GB

- **Problem: 32-bit physical address passed to boot driver**
  - **— Doesn't affect all boot drivers**

- **Options:**
  1. **Redesign boot driver interface for 64-bit addresses**
  2. **Provide PFN in 32-bits, with offset in virtual address**
  3. **Copy pages to be dumped to a physical address below 4GB**

- **Option 3 chosen**
  - **— Requires memory-resident libraries**
  - **— Attempts selective dump if insufficient pages available to borrow**

Resilience Improvements

- **Error log buffers dumped to SYS$ERRLOG.DMP**
  - **Always on system disk**
  - **Buffers dumped to both dump files on system crash**
  - **Buffers dumped only to SYS$ERRLOG.DMP on shutdown**
  - **System shutdown no longer overwrites crash dumps**

- **Selective dumps re-ordered**

V7.0	V7.1
Page tables	Page tables
S0 & S1 space	S0 & S1 space
S2 space	S2 space
Global pages	Key processes
Processes	Key global pages
	Other processes
	Remaining global pages

  - **Processes are dumped in two steps:**
    - **Page tables**
    - **P0, P1, P2 space**

Resilience Improvements

- **Key processes**
  - **Current process on crash CPU**
  - **Swapper**
  - **Current processes on other CPUs**
  - **Site-specific priority processes**
  - **Digital-defined priority processes**

- **Site-specific priority processes**
  - **Listed in** SYS$SYSTEM:SYS$DUMP_PRIORITY.DAT
    - **Shipped as a template**
    - **Enter UIC and process name**
  - **Run** SYS$SYSTEM:SYS$SET_DUMP_PRIORITY.EXE
    - **Run automatically during startup if data file exists**
    - **Can be run any time - e.g., RWAST process**

Resilience Improvements

- **Digital-defined priority processes**
  - **— [SYSTEM]MSCPmount**
  - **— [SYSTEM]AUDIT_SERVER**
  - **— [SYSTEM]NETACP**
  - **— [1,3]NET$ACP**
  - **— [1,3]REMACP**
  - **— [SYSTEM]LES$ACP**

Resilience Improvements

- **Improved handling of short dumps**
  - **Full dumps: all memory**
  - **Selective dumps: first process complete**
  - **Warning message from SDA if short dump**
  - **Warning message if accessing process not dumped or only partly dumped**

- **Check that .EXEs and .STBs read by SDA match images in dump**
  - **Link date/time must match**
  - **SYS$BASE_IMAGE.EXE checked three ways:**

    Link date/time of SYS$BASE_IMAGE.EXE in dump
    - vs -
    Link date/time in SYS$BASE_IMAGE.EXE used for symbols
    - vs -
    Link date/time of SYS$BASE_IMAGE.EXE that SDA$SHARE.EXE was linked against

  - **V7.1 Linker change was needed**

Resilience Improvements

- **Many causes of %SDA-E-NOREAD and %RMS-E-EOF removed**

- **New command: SHOW DUMP**

Qualifier	Display
/SUMMARY (default)	Dump summary
/HEADER	Formatted contents of header
/ERROR_LOGS	Summary of error log buffers
/COMPRESSION_MAP[=n[:m]]	Summary/details of compression data
/LMB[={ALL | n}]	Formatted contents of LMB header and the VA ranges dumped
/ALL	/SUMMARY/HEADER/ERROR_LOGS - /COMPRESSION_MAP/LMB=ALL
/BLOCK[=n[{: | ;}m]]	Hex dump of one or more blocks

Resilience Improvements

- "Override" mode
  - — ANALYZE/CRASH_DUMP/OVERRIDE
  - — Limited SDA command set:
    - . Organizational commands (SHOW DUMP, SET OUTPUT) available
    - . Memory access commands (EXAMINE, SHOW SUMMARY) not available
  - — New command only available in "Override" mode:

    MODIFY DUMP new_value

Qualifier	Meaning
/BLOCK (required)	Block to be modified
/OFFSET (required)	Byte offset within block
/BYTE	Field size to be modified
/WORD	...
/LONGWORD (default)	...
/QUADWORD	...
/CONFIRM (optional)	Old contents
/NEXT (optional)	Modify next byte(s)

    - . Header is marked when a dump is modified
    - . Should MODIFY DUMP be documented?

Minor Enhancements

- List is never-ending
- Items requested are done as/when it makes sense
- SHOW BUGCHECK [{code | name | /ALL}]
- SHOW ADDRESS address
- SET ERASE_SCREEN {ON | OFF}
- SHOW {GLOBAL_SECTION_TABLE | GST} [/SECTION_INDEX=n]
  - /SECTION_INDEX=n also added to SHOW PROCESS/PST
- SHOW GSD {/ALL | /SYSTEM | /GROUP | /DELETED | /ADDRESS=n}
- SHOW {WORKING_SET_LIST | WSL} [={type | index}]
  - Similar options added to SHOW PROCESS/WSL
- SHOW PFN: new qualifier /ZERO
- SHOW PFN: new qualifier /COLOR [={number | ALL}]
- VALIDATE PFN_LIST {/ALL | /FREE | /MODIFIED | /BAD | /ZERO}

Minor Enhancements

- **SHOW PFN, PAGE_TABLE, PROCESS/PAGE_TABLES: page table pages displayed as SPT(Ln), PPT(Ln), PHD**
- **SHOW PAGE_TABLE, PROCESS/PAGE_TABLES: new option =ALL**
- **SHOW PROCESS/PAGE_TABLES: new qualifier /PT**
- **READ:**
  - **— Added /NOLOG qualifier**
  - **— If filespec has no device/directory and is not found, SDA will look for it in directory SDA$READ_DIR**
- **SHOW POOL:**
  - **— Added /BAP qualifier for bus-addressable pool**
  - **— Added /SUBTYPE qualifier**
  - **— Ring buffer handles packets over 64K**
- **SEARCH: new qualifier /MASK=n**
- **SET OUTPUT: new qualifier /NOINDEX**
- **SHOW CRASH: new qualifier /CPU=n**

Minor Enhancements

- **SHOW CLUSTER:**
  - **— Added /ADDRESS qualifier**
  - **— Display software version and hardware name**
- **SHOW RESOURCE:**
  - **— Added /ADDRESS qualifier**
  - **— Display nodename with CSID**
  - **— Define symbol RSB**
- **SHOW LOCKS:**
  - **— Added /ADDRESS qualifier**
  - **— Display nodename with CSID**
  - **— Define symbols RSB, LKB, LCKCTX**

Other changes

- Improved compression algorithm
- Performance enhancements
- Selective dumps include transition pages still connected to processes
- Dump header checksum
- User-mode thread support
- Consistent display of quadwords
- Other projects adding code:
  - Memory channel
  - ATM
  - CIPCA
  - Discontiguous physical memory
  - etc.

CLUE Enhancements

- **Tracking SDA changes:**
  - **— Consistent display of quadwords**
  - **— Bus-addressable pool**
  - **— Discontiguous physical memory**
- **Taking advantage of SDA changes:**
  - **— CLUE HISTORY uses SET OUTPUT/NOINDEX**
- **CLUE CRASH enhancements:**
  - **— Better symbolization in execlets and images**
  - **— Tries to symbolize exception PC**
  - **— DECnet/OSI symbol files**
  - **— Full HALT context in case of HALT/RESTART bugcheck**
- **CLUE STACK enhancements:**
  - **— Better symbolization in execlets and images**
  - **— DECnet/OSI symbol files**
  - **— Tries to detect null frames**

CLUE Enhancements

- **CLUE MEMORY enhancements:**
  - **— Better loop detection in pool lists**
  - **— Largest free chunk displayed**
  - **— Summary line on page and swapfiles installed**
- **First CLUE command reads several .STBs**
- **CLUE SCSI recognizes DDR devices**
- **CLUE PROCESS/RECALL differentiates errors:**
  - **— No access to recall buffer**
  - **— Empty recall buffer**
  - **— Process has no CLI**

Questions?

Notes from the original presentation, captured here for the benefit of those not at the session.

- DEC 3000 issues with DUMP_DEV are permanent restrictions, not bugs.
- BOOTDEF_DEV provides a list of paths to the system disk, but only for booting. DUMP_DEV is the only variable used by BUGCHECK. Only if DUMP_DEV doesn't provide a valid device/file will BUGCHECK look at the system disk via the path used at boot time.
- SYS$ERRORLOG.DMP: Fixed length file. Error logs from prior shutdown/crash get overwritten.
- Any problem if processes listed in SYS$DUMP_PRIORITY.DAT don't exist? No.
- If base image link date/times don't match, does SDA abort? No - just warning.
- READ/EXEC/NOLOG suppresses list of images read to make errors/warnings more obvious.
- Confusion around duplicate errorlog info in dump file and errorlog file. Error log dump file used by SYSINIT to propagate error logs across crash, but you can extract the data from the errorlog dump file using ANALYZE/CRASH/OVERRIDE then CLUE ERRLOG then DIAGNOSE or ANALYZE/ERROR on the output. [Except I tried it & it doesn't work, but I'll fix that :-)]
- Much debate over documenting feature that allows dumps to be modified. Current wisdom is to document it, and advise that it is not for general use and may make the dumpfile unusable. At least this way those who need to use it have a prayer of doing it right. Could such modification been done with history like PATCH? Not with the present design of dump files.
- PFN coloring: documented in DOCD$:[EVMS.PROJECT_DOCUMENTS]DS-PAGE_COLORING.PS on STAR::.
- Does CLUE know not to read .STBs that SDA has already read? No.
- SCD Enhancements? Lots in the plans, not much done yet. Especially wanted is removing the need for a dedicated LAN adapter.