The Hercules S/370, ESA/390, and z/Architecture Systems Emulator

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Agenda

- Introduction
- What's new
- Capabilities
- Device emulations
- OS compatibility
- Performance
- Installation and configuration
- Operation
- Where to get more information

Introduction

- What is Hercules?
  - Emulates S/370, ESA/390, or z/Architecture CPU and peripherals
  - Runs under Linux, Windows 98/NT/2000/XP, BSD, Mac OS X
  - Portable to different host architectures and Unix-style operating systems
  - Hardware emulation only
  - Freely available
  - OSI Certified Open Source Software
  - Active user community

What's new?

- Current version: 2.16.5
  - Released July 8, 2002
  - PER
  - S/370 MP
  - CTCI for Windows
  - 3287 printer support
  - Licensed OS restriction
  - Preliminary LCS support
  - HTTP server

What's new?, continued

- Current release: 2.16.5
  - Print to Unix pipe
  - Improved performance
  - Many bug fixes
    - DASD characteristics
    - S/370 extended memory and interval timer
    - Internal locking

What's new?, continued

- Soon: 2.17
  - Restructured DASD subsystem
    - Compressed FBA device support
    - Framework to allow DASD sharing
    - RAS improvements
    - Supports large filesystems and device files > 2 GB
  - Internationalization
  - Performance improvements
  - Improved LCS support

Capabilities

- Today
  - Will run nearly all software written for S/370, ESA/390, and z/Architecture
  - No programs are known to not run when required facilities are present
  - Most architectural features that make sense for a single system supported
  - Minor bugs in the corners of the spec may remain

Capabilities

- Goal
  - Complete compatibility
  - Limited only by documentation and IP restrictions

Device emulations

- DASD
- Tape
- Card reader/punch
- Line printer
- CTCA
- Terminal

Device emulations: DASD

- Emulated via image on disk
- CKD, FBA supported
- Classical CKD devices from 2311 to 3390-9
- All known FBA devices
- Regular CKD and FBA files compatible with P/390
- CKD device files can be compressed, with improved performance
- CCKD files can reside on read-only media

Device emulations: tape

- SCSI-attached tape devices (Linux only)
  - 9-track, 3480, 4mm DAT, 8mm, QIC tested
- AWSTAPE files
- OMA tape files
  - Both same format as P/390
- Hercules Emulated Tape (HET)
  - Enhanced AWSTAPE, with compression
- Can emulate 3420 or 3480 drives

Device emulations: card reader/punch

- Card reader
  - ASCII and EBCDIC/binary input files supported
  - Translation automatically enabled if needed
  - Can IPL binary decks
  - Emulates 1442, 2501, or 3505
- Card punch
  - Emulated via output file on disk
  - Can punch with or without translation to ASCII
  - Emulates 3525

Device emulations: line printer

- Emulated via output file on disk or Unix pipe
- Fixed carriage control (3211 FCB support coming)
- Emulates 1403, 3203/3211

Device emulations: CTCA

- Emulated via external program, Linux device, or TCP port
- Design allows flexibility in actual facility
- One external program currently available: vmnet
- TUN/TAP device support for IP connections under Linux
- WinPCAP driver for IP under Windows 98/2000
- CTCA-to-CTCA to another Hercules system
- Emulates 3088, more or less

Device emulations: terminal

- 3270, 3287
  - Local, non-SNA controllers
  - Emulates 3274-41D
  - Supports capabilities of client program
  - Emulated via tn3270 session
  - Recommended clients
    - x3270 on Linux
    - Vista tn3270 on Windows
    - 3174 with Config Support C release 6

Device emulations: terminal, continued

- 1052/3215
  - Local console only
  - Emulates 1052 or 3215 console
  - Emulated via regular telnet session

OS compatibility

- Public domain OSes
  - OS/360
  - MVS 3.8J
  - VM/370 r6
  - DOS/VS r34
- Linux
  - Both 32- and 64-bit
  - Used for kernel development

OS compatibility, continued

- No formal IBM testing
- User reported successes
  - z/OS 1.1 and 1.2, including 64-bit mode
  - OS/390: from 1.2 through 2.10
  - VM: ESA 2.2, 2.4, 1.1.0 (370 Feature); SP: r5, r6
  - z/VM: 4.1
  - VSE: ESA 1.3.2, 2.2.0 through 2.4.0; AF 3.2

Licensing

- Hercules is ***NOT*** intended to be used to pirate IBM software!
- Configuration file parameter required to run ESA and z/Architecture program product OSes
- If you specify PGMPRDOS LICENSED, you accept responsibility for compliance
- How about a personal use license, IBM?

Performance

- Depends on host system
- Will make effective use of multiple host CPUs
  - Emulate multiple CPUs
  - Overlap I/O and CPU activity
- Dual 1 GHz Pentium III can sustain about 12 MIPS with moderate I/O load (500 SIO/second)
- 2 GHz Pentium 4 will peak over 20 MIPS
- Host RAID subsystem will dramatically improve I/O performance

Installation

- Windows or Linux?
  - Some features not supported under Windows
    - SCSI tape
  - Cygwin libraries needed for Windows
  - Most development done first on Linux
  - GUI available on Windows
- What else is that computer used for?
- Consider VMware

Installation

- Source tarball, RPM file, or Debian package for Linux
- Self-extracting installer for Windows
- Part of the FreeBSD packages collection
- Basic installation
  - Build package from source (if desired)
  - Install package
  - Create configuration file
  - Create DASD image files
  - IPL system

Versions

- Ongoing development is done collaboratively
- Periodic snapshots
- Bleeding edge available via CVS
- Version numbering:
  - Major releases: version/release (2.16)
  - Maintenance releases: version.release.modlevel (2.16.5)
  - Development releases: version.releaseletter.modlevel (2.16a.3)

Configuration

- Text configuration file
  - Analogous to IOCDS
  - Specifies system options and devices
  - Selected at Hercules startup by command-line option

Configuration: system options

- Specify behavior of entire processor
- Provide parameters for emulation facilities
- Most can be changed by control panel commands

Configuration: device entries

- Device entries follow system options
- One per device
- Specified as address, device type, device parms
- Parms specify filename and options

Building DASD images

- Three utilities: dasdinit, dasdload, and CCKDCDSK
- dasdinit makes empty volumes
  - Creates volume label
  - Initialize and load with normal IBM utilities
- dasdload builds volumes with data
  - Builds VTOC, EREP datasets, minimal OS CVOL
  - Creates empty datasets
  - Loads PDSes created with TSO XMIT
  - Optionally writes IPL text

Building DASD images, continued

- CCKDCDSK makes CCKD image files
  - Copies existing DASD volumes
  - Creates image file for download
  - Runs on MVS-style OSes
  - Also on CBT tape file 541

Building tape images

- AWSUTIL
  - CBT tape file 477
  - Creates AWSTAPE image with RECFM=VB
- RAWSTAPE
  - CBT tape file 478
  - Converts AWSTAPE files to RECFM=U sequential dataset
- VTT2TAPE, VTT2DISK, VTT2CNVU
  - CBT tape file 533
  - AWSTAPE images in RECFM=F/80 format

Operation

- Four control panels
  - Built in: graphical and command-line
  - Windows GUI
  - Web server
- Most commands available in all
- Usual operator facilities available: IPL, start, stop, interrupt, restart
- Device controls: attach/detach, interrupt, initialize
- Debugging: breakpoint, single-step, trace, register and memory alter/display
- HMC console commands and messages

Information on the web

- Hercules home page: http://www.conmicro.cx/hercules
  - Installation and operation documentation
  - Downloads
- Hercules on Windows: http://www.bsp-gmbh.com/hercules
- CBT CD-ROM Collection: http://www.cbttape.org
- Fish's Hercules Page: http://home.sprintmail.com/~dtrout/Hercules/hercgui-index.html

Mailing lists

- Hercules general mailing list: hercules-390
- OS-specific mailing lists:
  - MVS: H390-MVS
  - VM: H390-VM
  - DOS/VS: H390-DOS
  - VS/1: H390-VS1
- Arguments and advocacy: hercules-advocacy
- All at http://groups.yahoo.com/group/<name>

Appendix: system options

- CPUSERIAL, CPUMODEL
  - Set values returned by STIDP instruction
- MAINSIZE, XPNDSIZE
  - Allocate main and expanded storage
- CNSLPORT
  - Sets the TCP port terminal sessions connect to
- NUMCPU, NUMVEC
  - Number of CPUs, vector facilities online at IPL

Appendix: system options, continued

- LOADPARM
  - Same as IPL parameter on ESA hosts
- OSTAILOR
  - Turns off reporting for normal program checks
  - Sets other default values
- SYSEPOCH
  - Sets the year for TOD clock value of zero
- TZOFFSET
  - Adjusts clock to local time if desired

Appendix: system options, continued

- PANRATE
  - Sets refresh rate for Hercules control panel
- TODDRAG
  - Slows rate of emulated clock
- ARCHMODE
  - Selects the architecture to be emulated

Appendix: system options, continued

- IODELAY
  - Adds small delay to I/O completion interrupt processing
  - Needed to work around Linux bug
- PGMPRDOS
  - Must be specified to run OS/390, z/OS
  - Acknowledgment of user's responsibilities
  - A7A wait state at IPL if not specified