FreeBSD bhyve intro

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What is bhyve?

- bhyve == “bsd hypervisor”
- Minimal hosted hypervisor
  - FreeBSD analog of kvm + qemu
  - All code BSD 2-clause licensed
- In the FreeBSD base system since 10.0 (2014)
History

• Started as a skunkworks project at NetApp in late 2010
  • Provided a hypervisor alternative to ESXi (owned by a competitor)
  • Implemented on Intel Nehalem - first generation EPT
• Project died internally: code contributed to FreeBSD in May 2011
  • 8 vCPUs, x2apic, PV AP spinup, virtio net/block MSI, polled-mode uart.
• Lived in a project branch until merge to mainline, Jan 2013
• Shipped in 10.0-RELEASE, Jan 2014 (FreeBSD guests only)
• Ported to Illumos, MacOS (xhyve), Intel ACRN
Features #1

• Intel + AMD processor support (2nd-level paging required)

• Integration with FreeBSD: a VM is a process, vCPUs are threads, demand-paged guest memory.

• Battle-hardened device emulations:
  - PCI, virtio net/block/scsi/console/rng, e1000, ahci, nvme, xhci, 16550 uart, ps2 kbd/mouse, HDA audio, PC junk i/o (8254/ioapic/hpet).
  - graphical output via built-in VNC server and kbd/mouse/framebuffer emulation
  - PCI passthru
Features #2

- Guests:
  - *BSD 32/64-bit
  - Linux 32/64-bit
  - Windows 64-bit, desktop 7->10, server 2k8 -> 2019
  - Misc - Illumos, Plan9, etc
Structure

/usr/sbin/bhyve

libvmmapi.so

/dev/vmm

/vmm.ko

/usr/sbin/bhyvectl

libvmmapi.so

FreeBSD kernel services:
- timers
- memory allocation
- vm system
- interrupts
- ipi
Invocation

• “Build your own PC”

• Provide PCI slot structure, attached devices, and back-ends

• Plus global options (number of vCPUs, RAM, …)

• Not particularly user-friendly
  
  • Fully described in the bhyve(4) man page

  • Front-ends available (e.g. `vm-bhyve` from ports)

• FreeBSD Handbook a great resource
  
bhyve
  -c 2 \
  -s 3,ahci-cd,/images/en_windows_10_enterprise_x64_dvd.iso \ 
  -s 5,ahci-cd,./virtio-win-0.1.118.iso \ 
  -s 11,fbuf,tcp=0.0.0.0:5900,w=1280,h=720,wait \ 
  -s 12,xhci,tablet \ 
  -s 18,virtio-net,tap0 \ 
  -s 20,nvme,./win10.img \ 
  -s 31,lpc \ 
  -l bootrom,./BHYVE_UEFI.fd \ 
  -m 2G -H -w \
windows
Futures

• non-X86 support (ARMv8, Power9, riscV)
• Nested virt
• Host filesystem access (plan9fs, virtio-fs)
• Functioning GPU passthru
• USB device passthru
• Live migration
Questions ?