Bhyve guests with hardware accelerated graphics

Michael Chiu
EuroBSDCon 2019
Who am I?

Studying Pure Mathematics in San Jose, California

FreeBSD user since 4 years ago

Accidentally started programming
Reason for GPU accelerated Guests?
Possible methods to accelerate graphics applications of Bhyve guests

Application Level:

- Offload to another machine / server (for example: VirtualGL, rCUDA)

(Virtualized) Hardware level:

- GPU Passthrough
- vGPU (Intel GVT)
Is GPU Passthrough possible in bhyve?
It is possible but not perfect

The GPU must not be used by the host or any other virtual machines prior to passing through to the guest.

The only way to use the graphic card again is to reboot.

Does not automatically work and behave like a live physical graphics card for all OSes.
Prerequisites to Passthrough a GPU to guest

0) Any standard bhyve pci-passthrough requirements

1) The GPU must not be initialized yet

2) The Topology of the GPU needs to be trivial
   Counter example: Nvidia Optimus

3) Donate to one of the BSD projects
Attempts to work around the GPU initialization problem

Nvidia RX 2070 seems to lie about supporting FLR (function level reset)

Modified and make ppt to ignore FLR and force pci_power_reset devices listed in pptresetdevs in loader.conf

Nope, that does not help.
Real World Experiments

CPU: AMD Threadripper 1950X
RAM: 64GB 2933Hz DDR4

Motherboard: Gigabyte X399 Designare EX

OS: FreeBSD 13 CURRENT

GPU0 host, 1st PCIe Slot: Nvidia GTX 1050TI
GPU1 guest, 3rd PCIe Slot: Nvidia RTX 2070
GPU2 guest, 3rd PCIe Slot: AMD RX 580

All Guests installed on Samsung T5 SSD
Windows 10 Guests
Nope, won’t even boot properly
Possible reasons for failed passthrough to Guests (for example Windows)

According to Debian VGAPassthrough Wiki,

“The PCI geometry they create by default may violate guest OS graphics drivers' expectations by placing the GPU directly on the PCI root bus, or behind a PCI (rather than PCI Express bridge)”

But in order to Passthrough the GPU as X:0:0 in guest, we need to pass -Y to bhyve, but this usually crash bhyve as a result of

Assertion failed: (pi->pi_bar[baridx].type == PCIBAR_IO), function passthru_read
FreeBSD Guests
FreeBSD 12.0 Guest (Nvidia RTX 2070)

- Use Nvidia official driver for FreeBSD

- Must use uefi loader to enable vt console

- Console does not show on screen (as expected)

- Need to explicitly add BusID to xorg.conf

- Remove nvidia*_load="YES" from loader.conf

- Add nvidia and nvidia-modeset to kld_list instead

- Bonus: the USB-C port on the GPU works too (as xhci)
FreeBSD 12.0 Guest (RTX 580)

- Used drm-kmod driver

- bootable with uefi loader, bhyveload not tested

- Console show on screen after amdgpu loaded

- Using DRM, so does not require BusID in xorg.conf
Performance compare to bare metal

GLMark2 Score
Bare Metal: 26437
Virtual Machine: 17482
Intel GVT?

Intel technology that allow to create virtual GPU from iGPU, that can pass through to virtual machines.

Most of the code are already in i915 DRM driver
Future work/Work in progress