Enable GPU Virtualization in OpenStack
About Us

- Howard Huang: Standard Engineer and open source community operation manager, from Huawei (IRC: zhipeng)
- Lei Zhang: Cloud software engineer, from Intel (IRC: lei-zh)
- Shaohe Feng: Cloud software engineer, from Intel (IRC: shaohe_feng)
- Yingxin Chen: Cloud software engineer, from Intel
Agenda

• Motivation
• Intel GPU Virtualization Overview
• OpenStack vGPU enhancement
• Future Work
Motivation

Automatic Driving

Video Streaming

Cloud Gaming

Character image courtesy of Cyttex
Motivation

GPU virtualization becomes a fundamental requirement

GPU Accelerated Tasks
- Computer Aided Design
- Video Playback
- Media Transcoding
- Web Experience
- Office Productivity
- User Interface
- Games
- Weather broadcast

Performance → Direct GPU acceleration
Capability → Consistent visual experience
Sharing → Multiple Virtual Machines

Motivation

3D Graphics
Media
Compute
Motivation

*Other names may be the trademarks of their respective owners.
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Intel GPU Virtualization Overview

**API Forwarding**

- VM Frontend
- DirectX* APIs
- OpenGL* APIs
- Backend APIs
- Hypervisor
- Performance Feature Sharing

**Direct Pass-Through**

- VM Frontend
- Graphics Driver
- Hypervisor
- Performance Feature Sharing

**Full GPU Virtualization**

- VM Graphics Driver
- Device Model
- Hypervisor
- Performance Feature Sharing
Benefits of Intel GVT-g Technology

Performance
- 3D >80%
- 2D > 70%
- Media Decode > 90%
- Media Encode > 80%

Features
- Running Native Driver
- DirectX* 11.1
- OpenGL* 4.2
- OpenCL* 1.2
- MediaSDK 16.2
- DirectX* 12

Sharing
- Multiple VMs up to 15
- Guest OS:
  - Ubuntu*
  - Windows* 7 x32/x64
  - Windows* 8 x32/x64
  - Windows* 10 x64
Implementations of Intel® GVT-g Technology

• Intel® server platform support
  • From Xeon E5v4 platform

• In Linux kernel and hypervisors
  • Intel® GVT-g for Xen – XenGT
  • Intel® GVT-g for KVM – KVMGT
New Cloud Friendly Features

- Live Migration support for virtual GPU devices.
- QoS support in cloud environments.
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OpenStack vGPU enhancement – Nova Centric (Option 1)

KVMGT enabling in Nova service

Controller-node

Compute-nodes

nova-api

nova-compute

libvirt

KVMGT-qemu

libvirt driver

VGPU

intel

Huawei

OpenStack
OpenStack vGPU enhancement – Nova Centric (Option 1)

**VGPU as PCI devices**

- PCI device
  - Address: [Domain:Bus:Slot.Function]
  - Vendor ID
  - Product ID
- SRIOV
  - PF,VF vs PGPU,VGPU
- PCI tracker in Nova
  - VID, PID, Domain, Bus
  - Slot, Function, Parent address
  - Whitelist

VGPUUs are not real PCI devices 🙁
OpenStack vGPU enhancement – Nova Centric (Option 1)

Add a new kind of resource

- Request with flavor
- Scheduling
- Claim check
- Resource tracking
- Place the VM
- Rolling upgrade
- extra-specs
- new kind of filter and weigher
- check and consume GPU resources
- report available GPU resources
- update compute-node record
- persist instance record with usage

Complicated 😞
OpenStack vGPU enhancement – Dedicated Service (Option 2)
OpenStack vGPU enhancement – Dedicated Service (Option 2)

VGPU as dynamic resources

On demand resource allocation

- Resource pool: low-gm, high-gm, fence
- Resource capabilities
- Configurable flavor:
  - Flexible
  - Descriptive
- Safety

Flavor for web

Flavor for VDI

Flavor for media server
OpenStack vGPU enhancement – Dedicated Service (Option 2)

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Future Work

• Libvirt support
• GPU resources report
• Citrix implementation based on XenGT: https://review.openstack.org/#/c/280099/
• Nomad implementation
• Generic solution for graphic virtualization
Resources Links

• Get KVMGT from 01.org

• Libvirt enhancement for KVMGT.
• OpenStack enhancement for KVMGT.
Welcome to Nomad design session on Friday

• Room 130
• Time: Friday, 10:50am

• https://www.openstack.org/summit/barcelona-2016/summit-schedule/events/17242/nomad-work-session