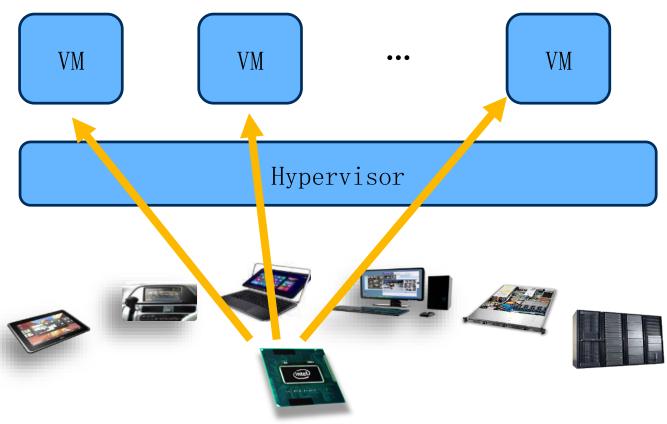
# An Introduction to Intel GVT-g (with new architecture)

Zhi Wang zhi.a.wang@intel.com WW24'17



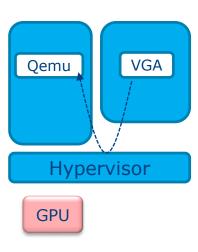
#### **GPU Virtualization**



Intel Processor Graphics

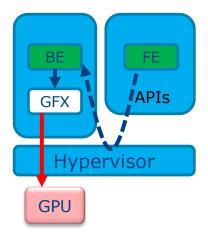
### Existing Arts vs Intel GVT-g

Legacy VGA Emulation



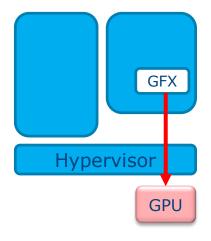
- 2D only

API Forwarding



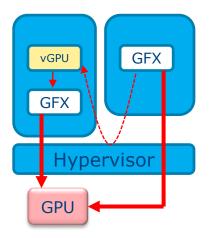
- +3D
- +Sharing
- Media/compute
- Compatibility

Direct Pass-Through



- +3D/media/compute
- +Performance
- No sharing

Full GPU Virtualization



- +3D/media/compute
- +Performance
- +Sharing



## Intel GVT-g Capabilities

Performance

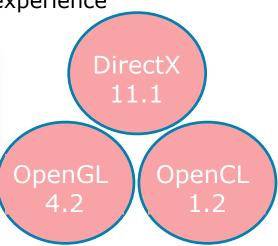
Feature

Sharing

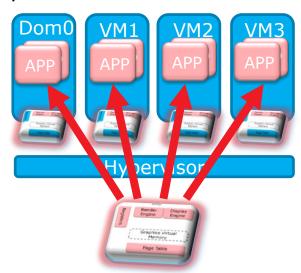
Near native performance with direct GPU execution

120
100
80
40
40
20
0
LightsMark OpenArena UrbanTerror Nexuiz

Run native graphics stack to sustain visual experience

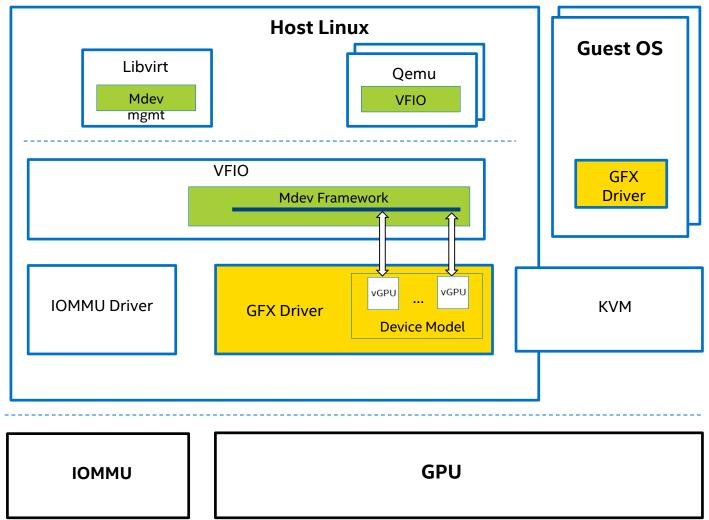


Accelerate up to 8 VMs plus Dom0





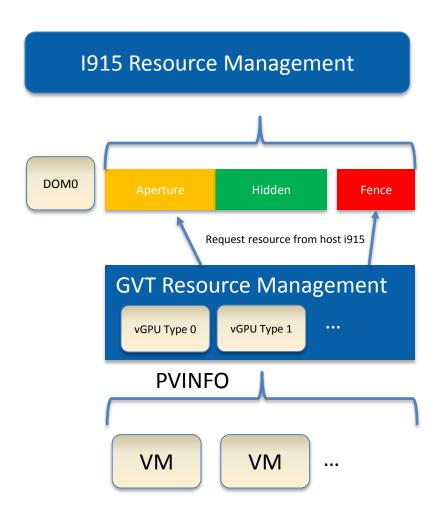
# GVT\_g (KVMGT) Architecture





#### Resource Management

- vGPU resources
  - Graphics memory
  - Fence registers
- Request GPU resource from host resource allocator
- GVT manages vGPU resource according to vGPU types



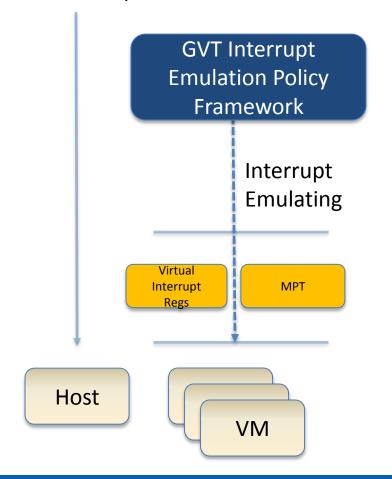


#### Interrupt

#### Full GPU interrupt virtualization

- Display Interrupts
  - VBlank
  - GMBUS
  - AUX Channel
- GPU command Interrupts
  - MI\_USER\_INTERRUPT
  - PIPE\_CONTROL\_NOTIFY
- Context Switch Interrupts

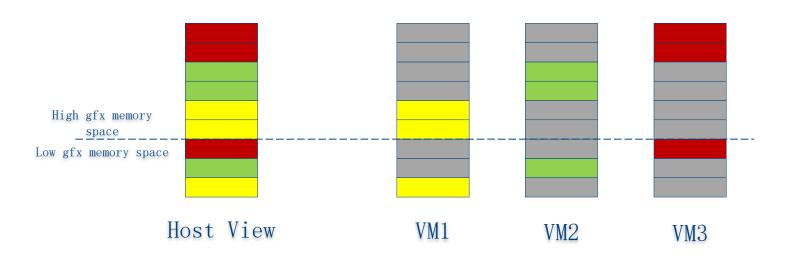
#### **GPU Interrupts**

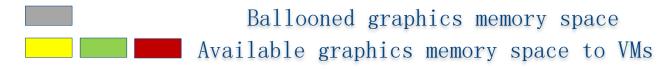




#### Shadow GPU Page Table - GGTT

- Global graphics memory space (GGTT) is partitioned
  - Dedicated resource for each VM



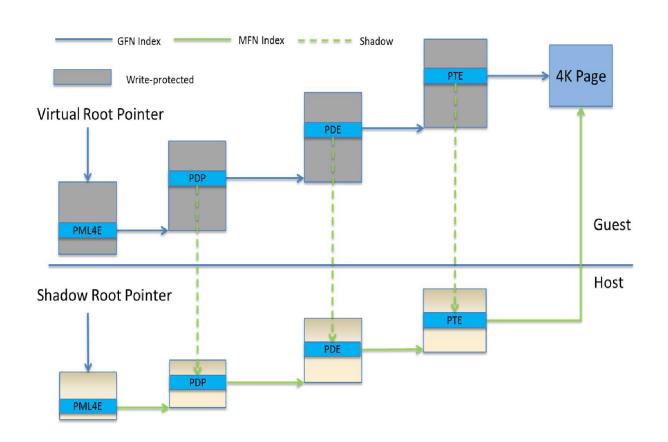




## Shadow GPU Page Table - PPGTT

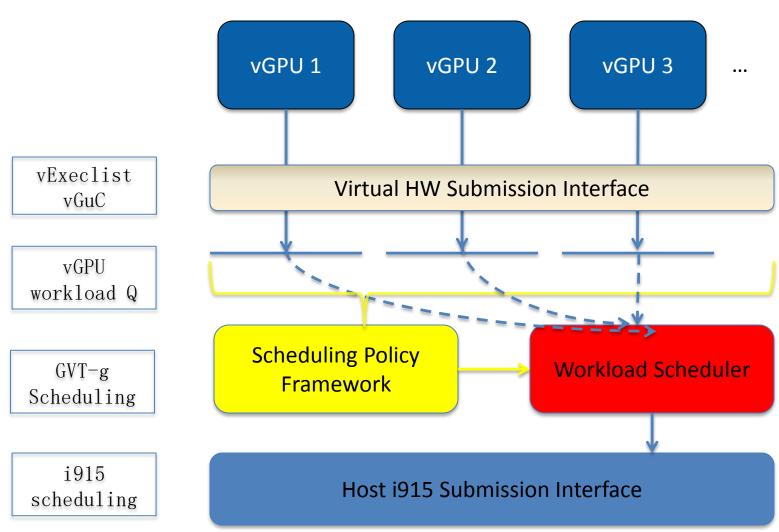
#### **Features**

- 2/3/4 level page table
- True per-process
   PPGTT
- Page table cache
- Reference counting
- Out-of-Sync shadow



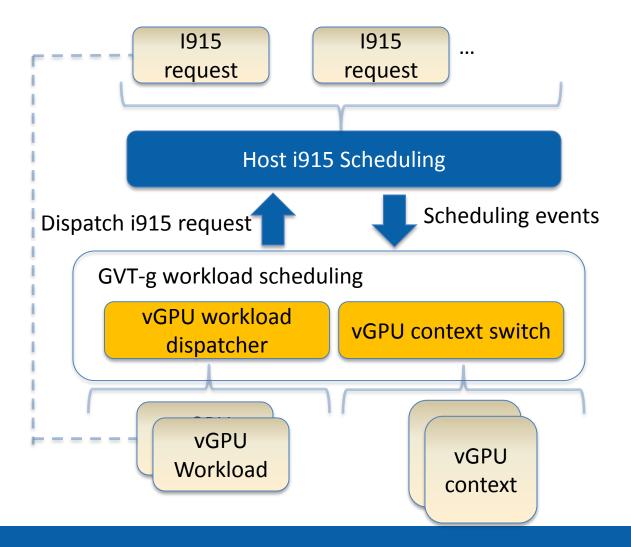


# Scheduling





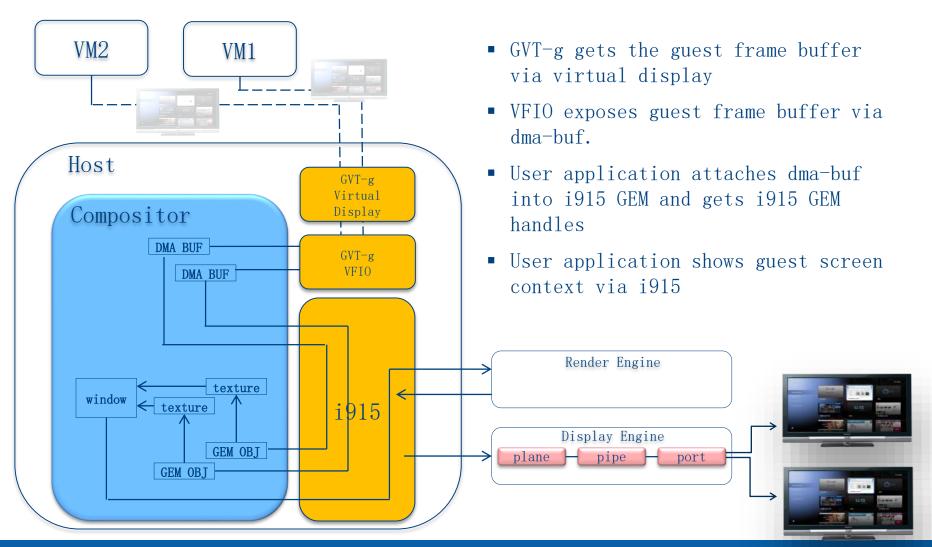
## Scheduling



#### Scheduling **MMIO** Emulation Virtual HW submission – vExeclist / vGuC Workload Q intel\_vgpu\_workload Schedule Workload scheduler Pick workload from Q Notify virtual HW submission layer Scheduling Policy = = Shadow context & ring buffer Framework Submit shadow context & ring buffer to i915 Wait workload finished Complete workload - - -Host i915 Submission System



#### Display



#### **Thanks**

