VFIO, OVMF, GPU, and You
The state of GPU assignment in QEMU/KVM
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The current state of VGA assignment
VGA assignment defined:

- Graphics card assigned as primary graphics for the VM
- Uses VGA BIOS for initialization and runtime services
Status:

- Works for discrete graphics cards
  - AMD Radeon (HD5xxx+)
  - NVIDIA GeForce (8-series+)
- Requires experimental vfio-pci option
  - x-vga=on
- Requires working VGA arbitration
- Still some device specific glitches
  - BSODs with AMD Catalyst + HDMI audio
  - Reset issues on some Radeon cards
  - Code 43 on GeForce
Issues:

- Requires *experimental* vfio-pci option, x-vga=on
  - Not supported by libvirt because experimental
  - Experimental because...
- Requires working VGA arbitration
  - Drivers don't participate (vgacon)
  - Drivers lie (i915)
  - Xorg DRI can't handle multiple arbitration participants
Can't we fix these?

- Drivers don't participate
  - fixable
- Drivers lie
  - Once upon a time...
    - i915 hardware allowed control of VGA resources
    - designers dropped this feature
    - nobody noticed?!
    - i915 continues to opt-out anyway
  - But if we fix that...
- Xorg DRI can't handle multiple arbitration participants
Start with fixing Xorg

DRI wants to mmap VGA MMIO space

Possible options...
- Provide a new VGA arbiter interface allowing mmaps
- Remove the mmap requirement

But what about compatibility?

“We DO NOT BREAK USERSPACE!”
-Linus Torvalds
VGA assignment status:  
Stuck
What else could we do?
Do we really need VGA?
Secondary graphics

- Emulated VGA for VM primary display
- Assigned graphics card for secondary
- Supported by NVIDIA
  - Requires K-series Quadro/GRID/Tesla
  - Supported in RHEL7.0
- Some reports of success with Radeon

Depends on guest driver support
Legacy-free UEFI VM

- No VGA required

No VGA arbitration required!
Problem solved?

VGA Issues:

- Requires "experimental" vfio-pci option
  - Not supported by libvirt because experimental
  - Experimental because...
- Requires working VGA arbitration
  - Drivers don't participate (vgacon)
  - Drivers lie (i915)
  - Xorg DRI cannot handle multiple arbitration participants
No Blockers
How do UEFI?
Step 1: OVMF
Open Virtual Machine Firmware
An implementation of UEFI built on the EDK II code base
Replaces Seabios
OVMF Setup

via command line:

```
/usr/libexec/qemu-kvm ...
    -drive if=pflash,format=raw,readonly,file=/path/to/OVMF_CODE.fd \
    -drive if=pflash,format=raw,file=/copy/of/OVMF_VARS.fd
```

via libvirt:

```
<domain type='kvm'>
    ...
    <os>
        <loader readonly='yes' type='pflash'>/usr/share/edk2.git/ovmf-x64/ovmf-code-pure-efi.fd</loader>
        <nvram template=':/usr/share/edk2.git/ovmf-x64/ovmf-vars-pure-efi.fd'/>
    ...
</os>
</domain>
```
Step 2: EFI graphics card ROM

PCI ROMs can support multiple images
Most newer cards already support EFI
Step 3: UEFI compatible guest

Newer versions of Linux
Windows 8, Server 2012
That's it!
Other GPU Topics
440FX vs Q35
Q35 originally recommended for VFIO-VGA

Largely FUD
- Q35 looks more like the host platform
- Some Linux drivers assume an upstream PCIe port

In reality
- Windows doesn't care
- Linux is fixable

440FX is likely the easier path for Windows guests
NVIDIA: Code 43

Driver detects KVM hypervisor, fails to initialize
Nvidia - "Accidental" breakage, won't fix, unsupported
We can't solve it, but we can work around it
Hide the hypervisor

via command line:

```
-cpu [type],kvm=off
```

via libvirt:

```
<domain type='kvm'>
  ...
  <features>
    <kvm>
      <hidden state='on'/>
    </kvm>
  ...
</features>
</domain>
```

*NVIDIA driver version 338.77+*
NVIDIA: Code 43 Redux

Driver detects Hyper-V extensions, fails to initialize*

Workaround: Disable use of Hyper-V extensions
Performance hit for Windows VMs
Have we entered an arms race?

*NVIDIA driver version 344.11
Quirks

GeForce: One still required*

Radeon: Not needed!

*QEMU now enables this independent of x-vga (2.2)
Unresolved Issues

- Radeon device resets
  - Sea Island GPUs don't reset correctly
    - SMC firmware issue?
  - Southern Island GPUs indicate PM reset capability
    - doesn't work
- Radeon BSOD
  - Typically resolved by avoiding audio function
- Intel Graphics support
  - In progress? KvmGT?
- Host/Guest suspend
  - And ponies!
Resources

- VFIO tips and tricks blog:
  http://vfio.blogspot.com
- This presentation:
Thank you