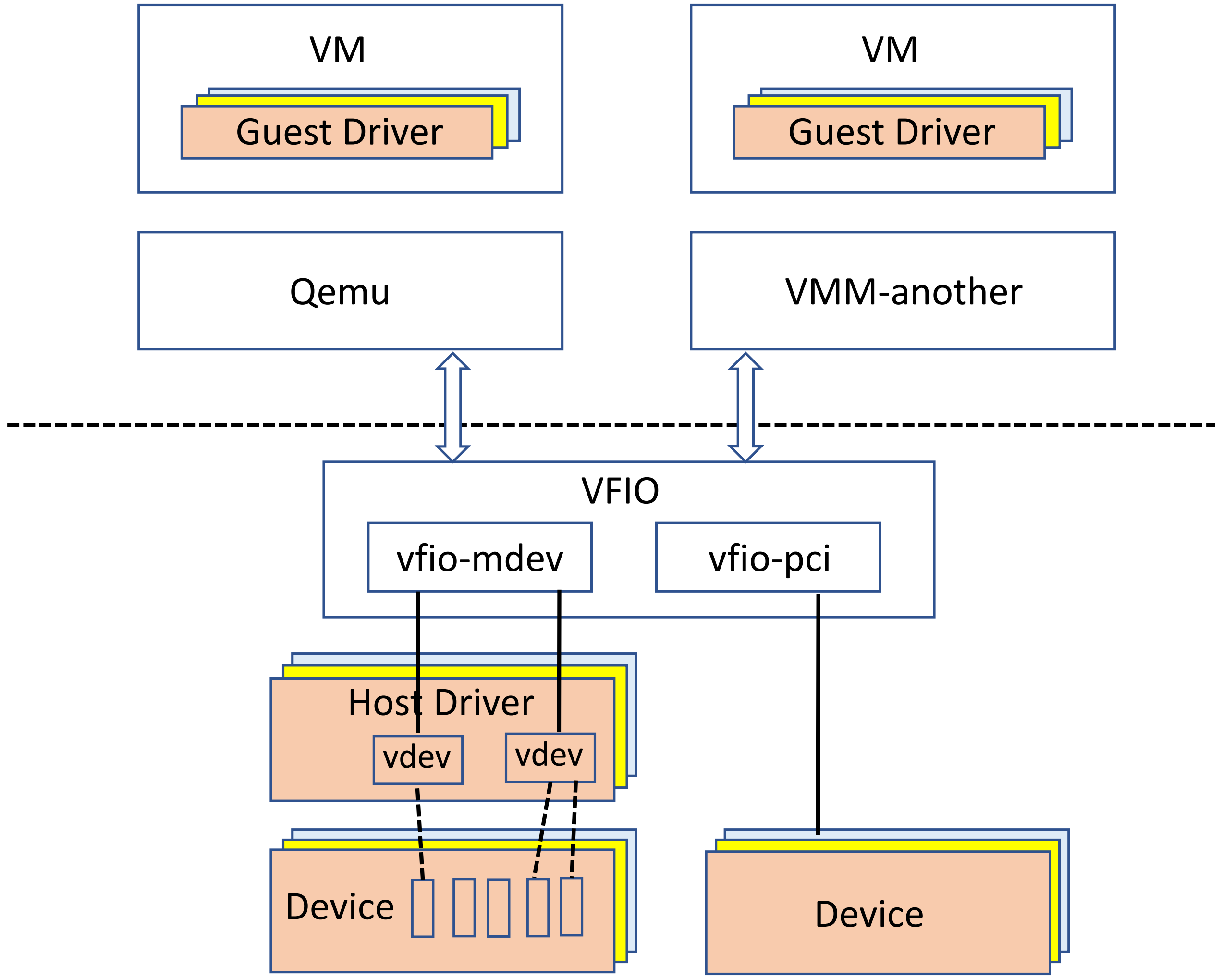
Criteria of Using VFIO Mdev (vs. Userspace DMA)

Kevin Tian, Ashok Raj

Purpose of Discussion

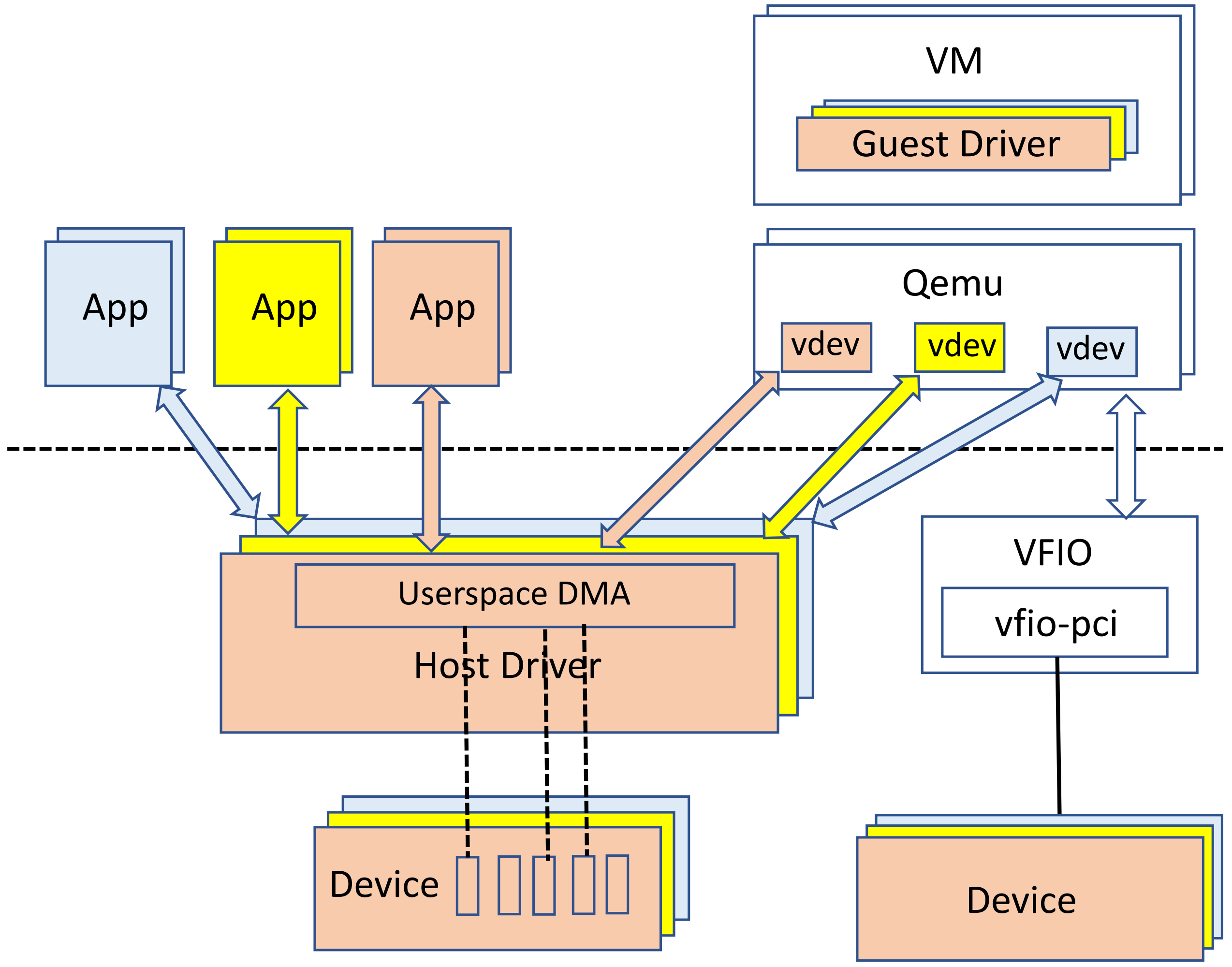
- VFIO mdev is the subdevice passthrough framework since 2017
  - Standard uAPI but require some emulation in kernel
- In-kernel emulation raises concern recently
  - When pushing a new mdev implementaion for IDXD device
- To be discussed in this session
  - Is it acceptable to put device emulation in kernel?
  - If no, what is the right approach?
  - If yes, how to prevent abuse of this framework?

VFIO MDEV



- In-kernel subdevice passthrough framework
  - Work queue, queue pair, context, etc.
  - vGPUs, Channel I/O devices, crypto devices, etc.
- Same uAPIs for device/subdevice passthrough
  - Existing VMMs just work!
  - Require some degree of emulation in host driver
    - Wrap subdevice as a virtual device (e.g. PCI)
    - Mediate control operations on subdevice
- Opens raised when using mdev in IDXD driver
  - Is it acceptable to put emulation in kernel?
    - E.g. low-risk pci cfg + simple mmio emulation…
  - If no, should vfio-mdev be deprecated and replaced by userspace DMA frameworks?
  - If yes, how to prevent abusing it as easy path to hook into virtualization stack?

Userspace DMA



- Allow userspace to directly ‘access’ device
  - E.g. mmap the command portal and submit workload
- Could be expanded for subdevice passthrough
  - Then contain vdev emulation in userspace
  - From ‘allow-access’ to ‘allow-control’
  - Meet virtualization demand
    - DMA map vs. vSVA, posted intr, live migration, etc.
- However,
  - Every driver requires specific uAPI support in all VMMs!
    - Although the real user is inside guest
  - Handling ‘control’ may increase uAPI complexity a lot
    - Modern ‘access’ uAPI is very simple (e.g. uacce)
    - ‘control’ uAPI might become a device API, to cover requirements from different guest Oses
  - Some degree of uAPI duplication
- It is not a net win over vfio-mdev!
  - VFIO wins on vendor agnostic uAPI

Proposal

- VFIO mdev has its merit as a standard subdevice passthrough framework
  - It’s fine if some driver wants to do its own way
  - But if vfio-mdev is used, we need criteria/process to catch any abuse

- Thoughts on preventing abuse:
  - A voting process similar to virtio
    - How to catch new attempt of mdev implementation?
  - A new mailing list for focused review/discussion of mdev implementations
    - Or, using KVM mailing list is sufficient?
  - Reduce code duplication
    - E.g. PCI Cfg space emulation, ioctl helpers, etc…
  - Explore moving some emulation to userspace
  - …

Backup

History of VFIO MDEV

- Initial discussion (link) about a common mdev framework for vGPUs
- Converged proposal presented in KVM forum 2016 (link)
- Vfio-mdev debuted in kernel 4.10 (2017), with KVMGT as the 1st user
- Other mdev implementations came in following years (s390 channel I/O devices, crypto devices, etc.)
- Recent hardware assistence (e.g. Intel Scalable IOV) allows reduced complexity and increased scalability (link)