KVM Live Upgrade with Properly Handling of Passthrough Devices

Zhimin Feng

ByteDance

Agenda

- Background
- How to handle the passthrough devices
- Downtime Optimization
- Achievements

Background

ByteDance

Background

Add security patches and new features:

- kernel live patching.
  - ➢ cannot handle complex changes
- Virtual Machine (VM) live migration.
  - ➢ incur unacceptable long delays

Background

VMM live upgrade:

- add security patches and new features.
- upgrade the whole VMM (KVM & QEMU) without interrupting customer VMs.

Background

Interrupts handling is difficult for passthrough devices during live upgrade.

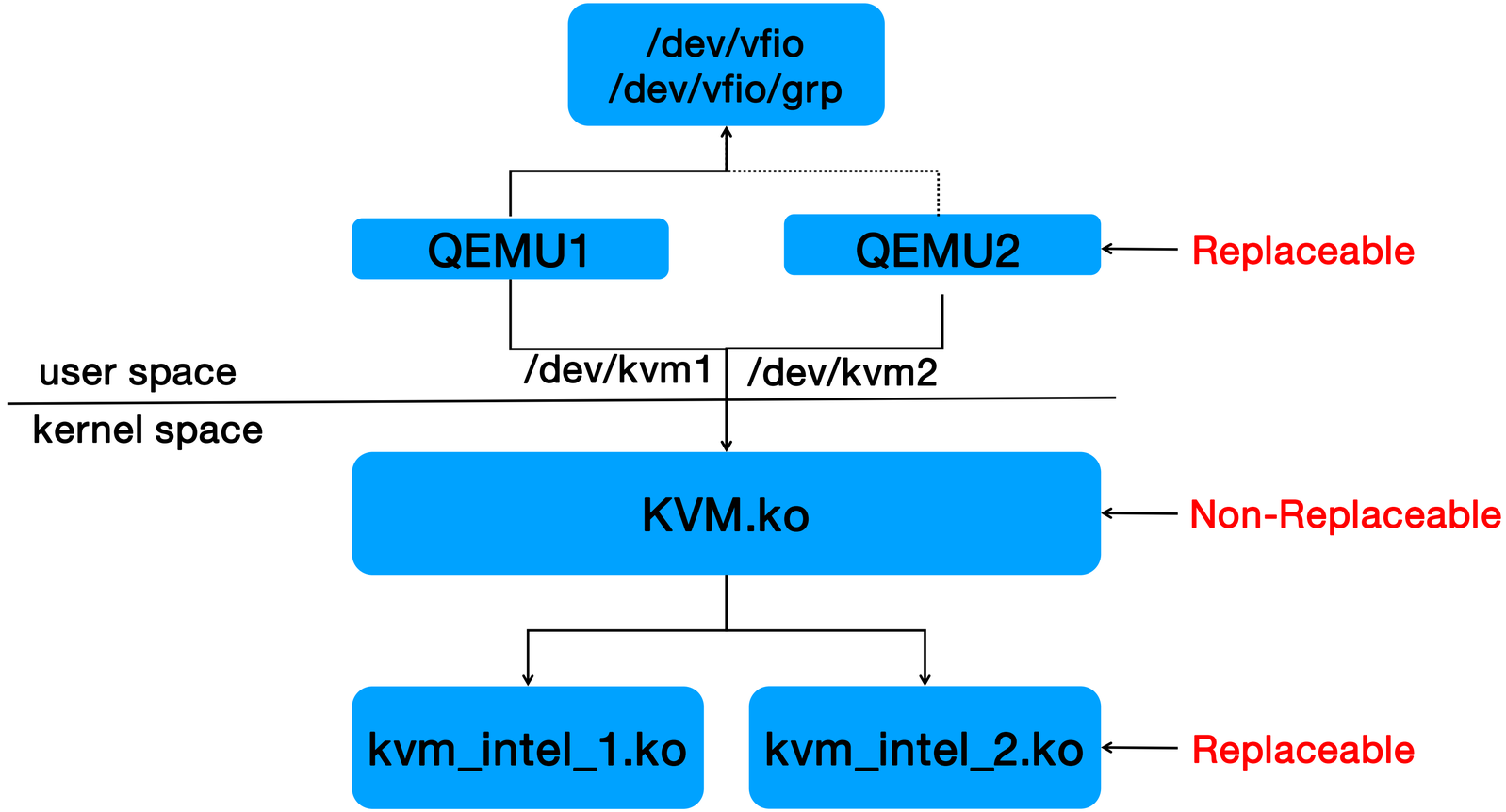
Minimizing service downtime is the major concern of cloud providers.

Handle
the passthrough devices

ByteDance

Live upgrade - framework

- Divide KVM module to multiple modules.
- New QEMU inherits vfio connector from Old QEMU.
- The VM's memory is shared by the new and old QEMU processes.



Passthrough device

Handling Passthrough device is difficult during live upgrade.

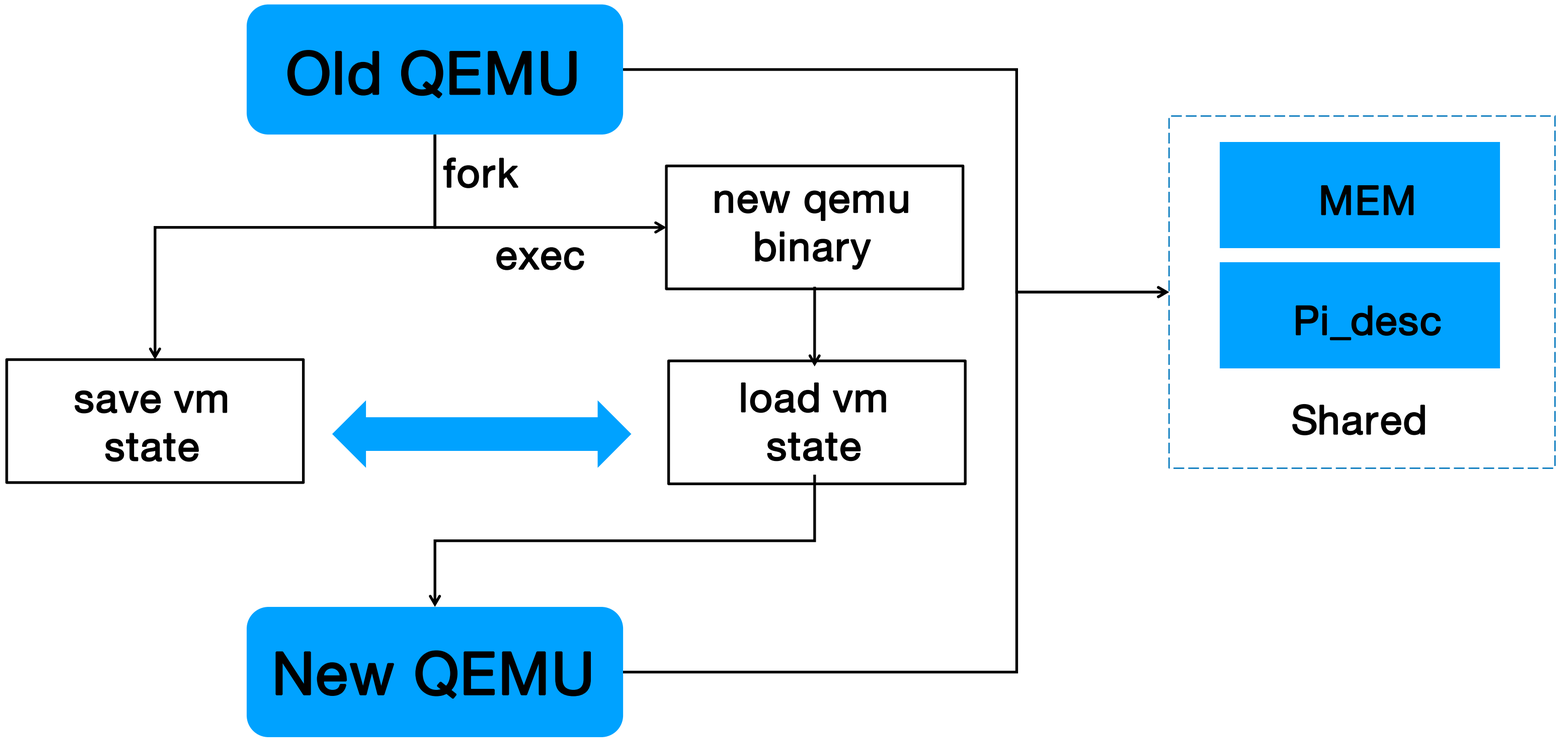
- Passthrough device cannot be suspended.

Existing Solution

- New QEMU Inherits vfio eventfds from old QEMU.
- New QEMU reads from the eventfd and receives the pending interrupts
- Inject an additional virtual irq into the VM.

Our solution - framework

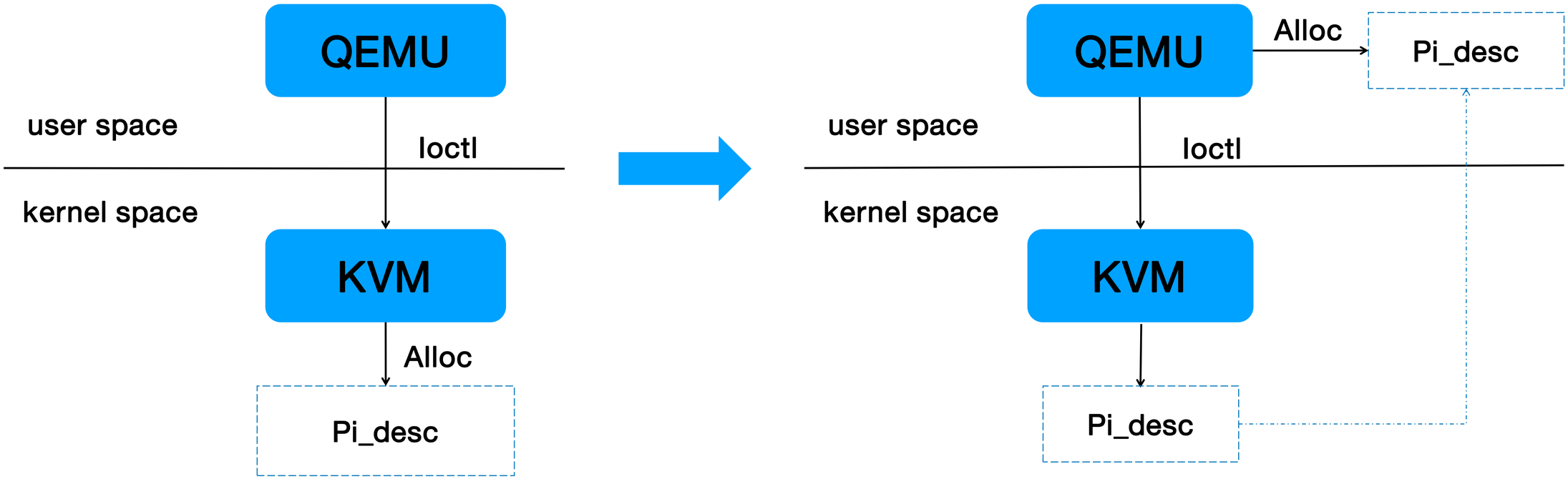
- VT-d Posted-Interrupts Support.
- Pi_desc is shared between New QEMU and old QEMU.
- Interrupts is consistency between New QEMU and old QEMU.



Our solution

Alloc Pi_desc structure

allocated memory for Pi_desc structure in QEMU



Our solution

Initialize Pi_desc data

- New QEMU does not initialize the pir data.
- New QEMU does not sync the pir from Old QEMU.
- New QEMU does not update the Interrupt Remapping Table.

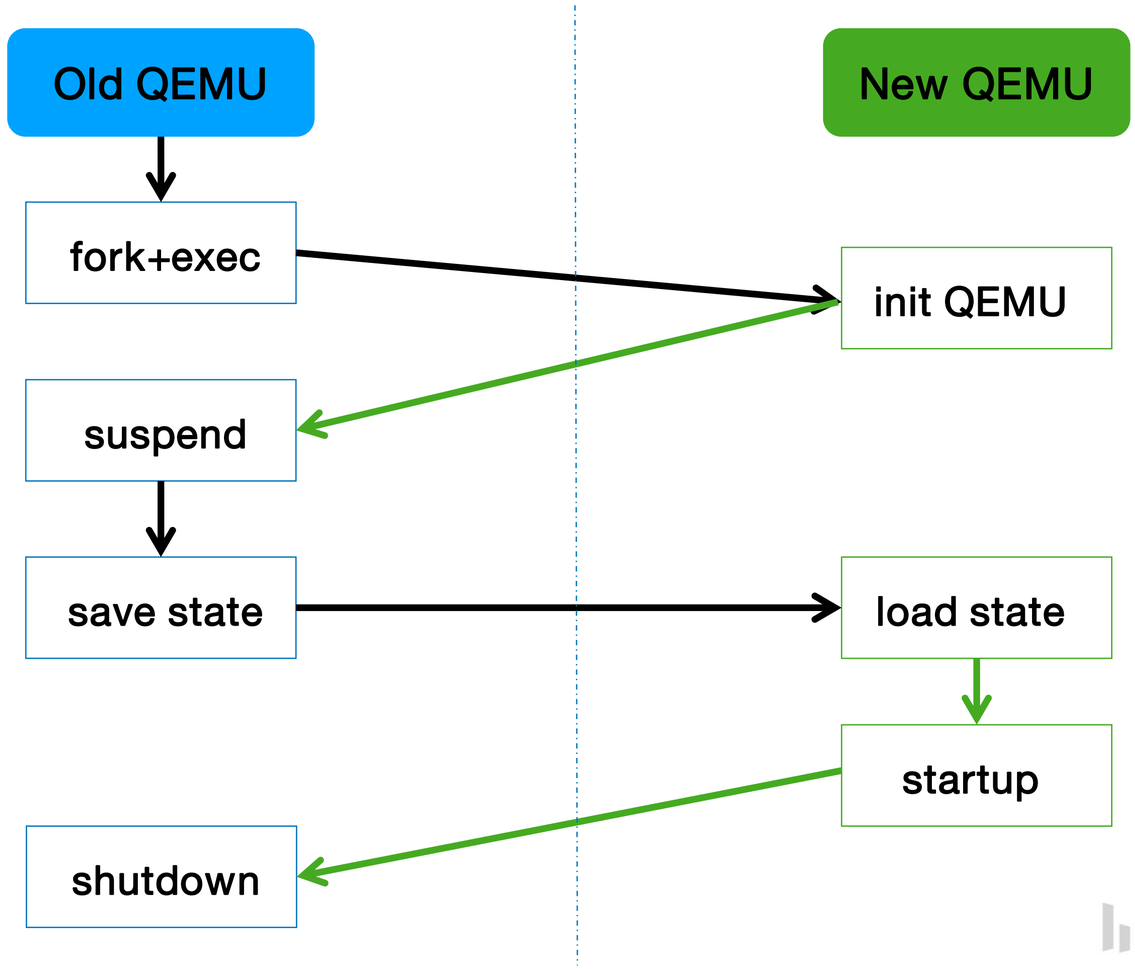
Downtime Optimization

ByteDance

Downtime optimization

Live upgrade flow diagram

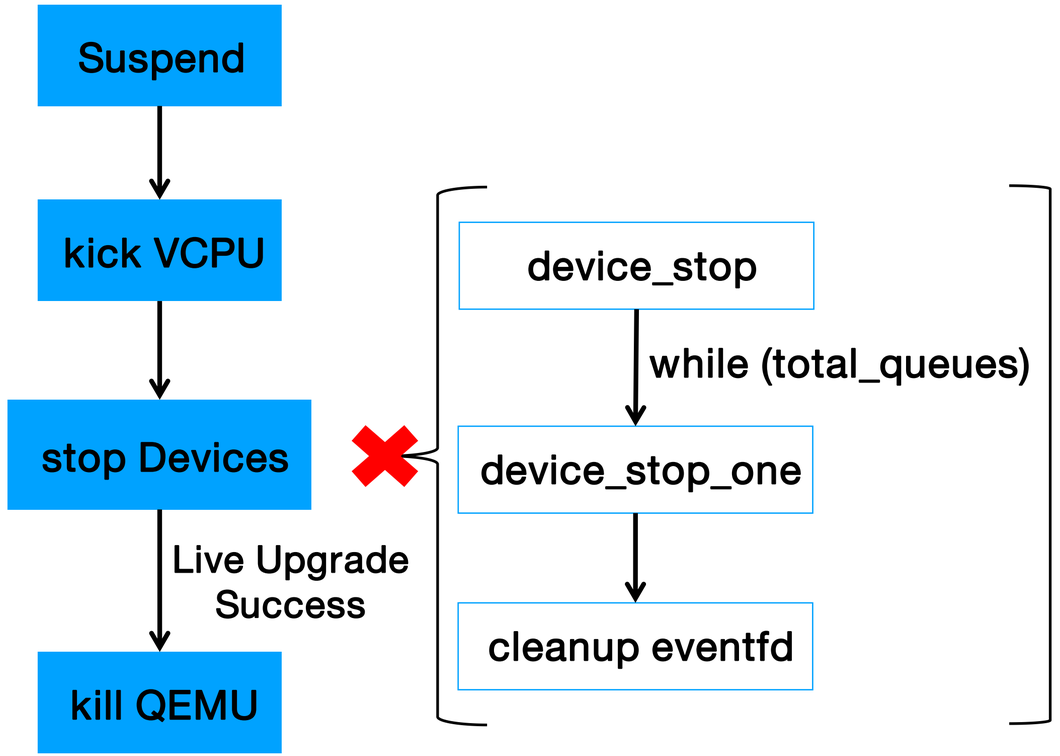
- Downtime phase
  - suspend
  - save state
  - load state
  - startup



Downtime optimization

Suspend optimization(Old QEMU)

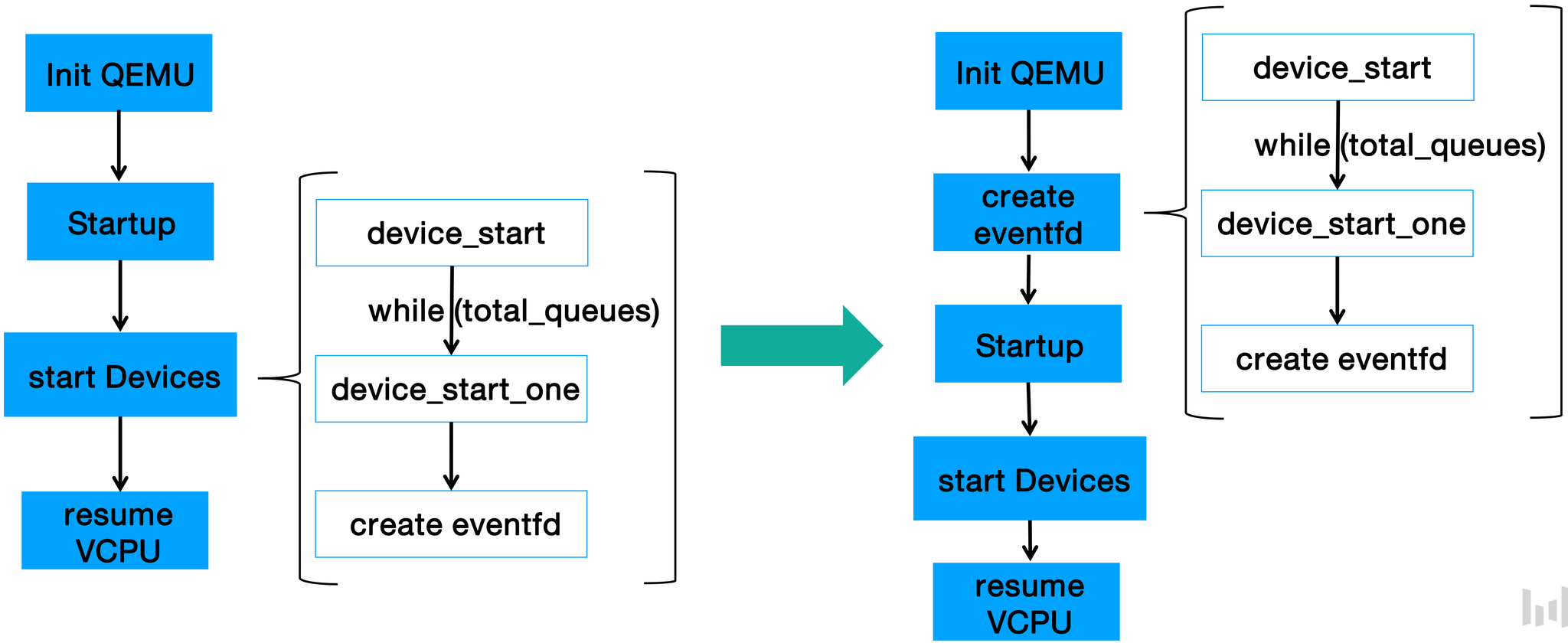
- Don't cleanup eventfds for virtio devices.



Downtime optimization

Startup optimization(New QEMU)

- Create eventfds for virtio devices during QEMU initialization.



Downtime optimization

Save/Load state:

- Using shared memory to save/load vm state.
- Loading state in the new QEMU happens concurrently with saving state in the old QEMU.

Achievements

ByteDance

Downtime

- 8 vcpu, 16GB RAM, 2 Cloud Disk(100GB, 200GB), Mellanox Technologies MT27800.
- 64 vcpu, 128GB RAM, 2 Cloud Disk(100GB, 200GB), Mellanox Technologies MT27800.
- 88 vcpu, 350GB RAM, 2 Cloud Disk(100GB, 200GB), Mellanox Technologies MT27800.

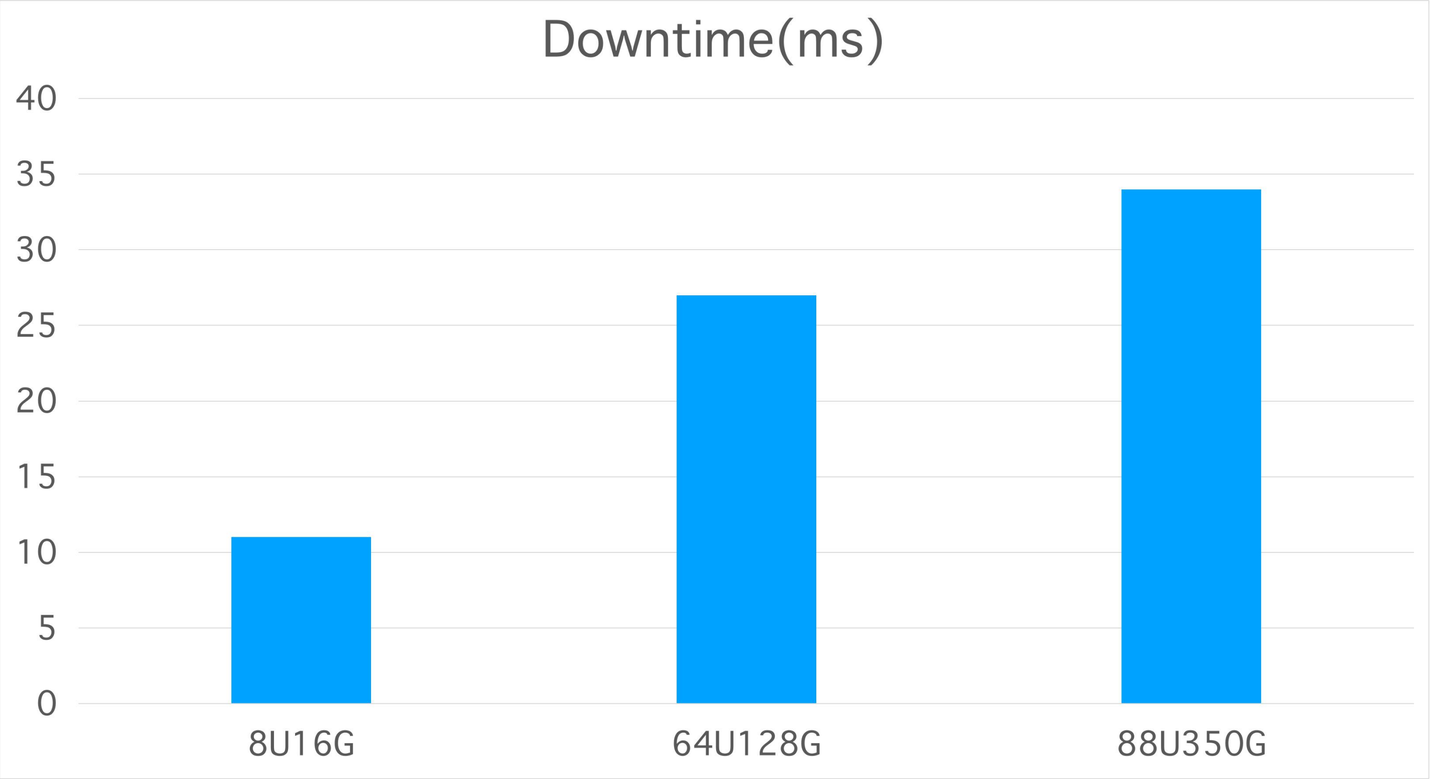
Workload:

- idle
- cpu_stress
- memtester
- fio:

Downtime

VM workload: idle

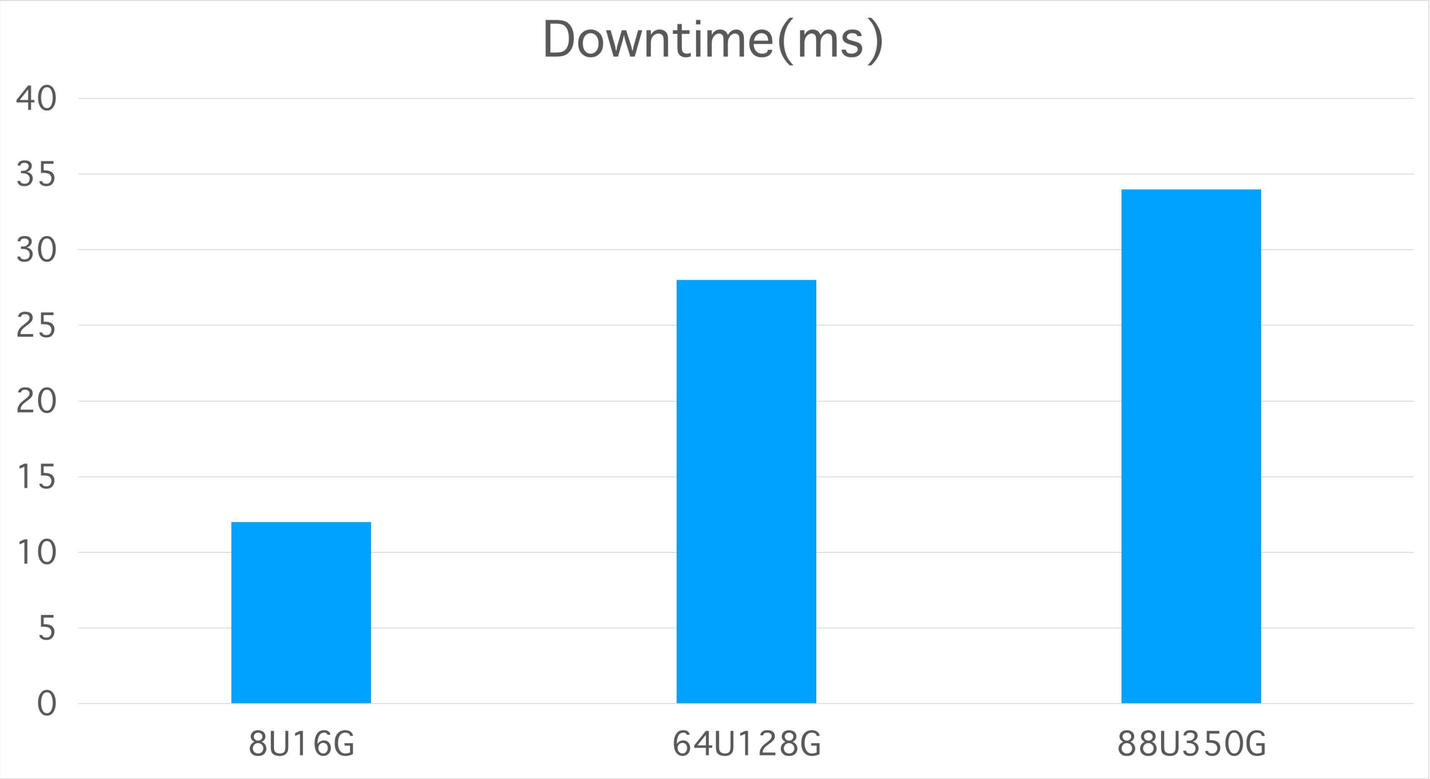
- vcpu downtime: 11ms ~ 34ms



Downtime

VM Workload: stress -c 4

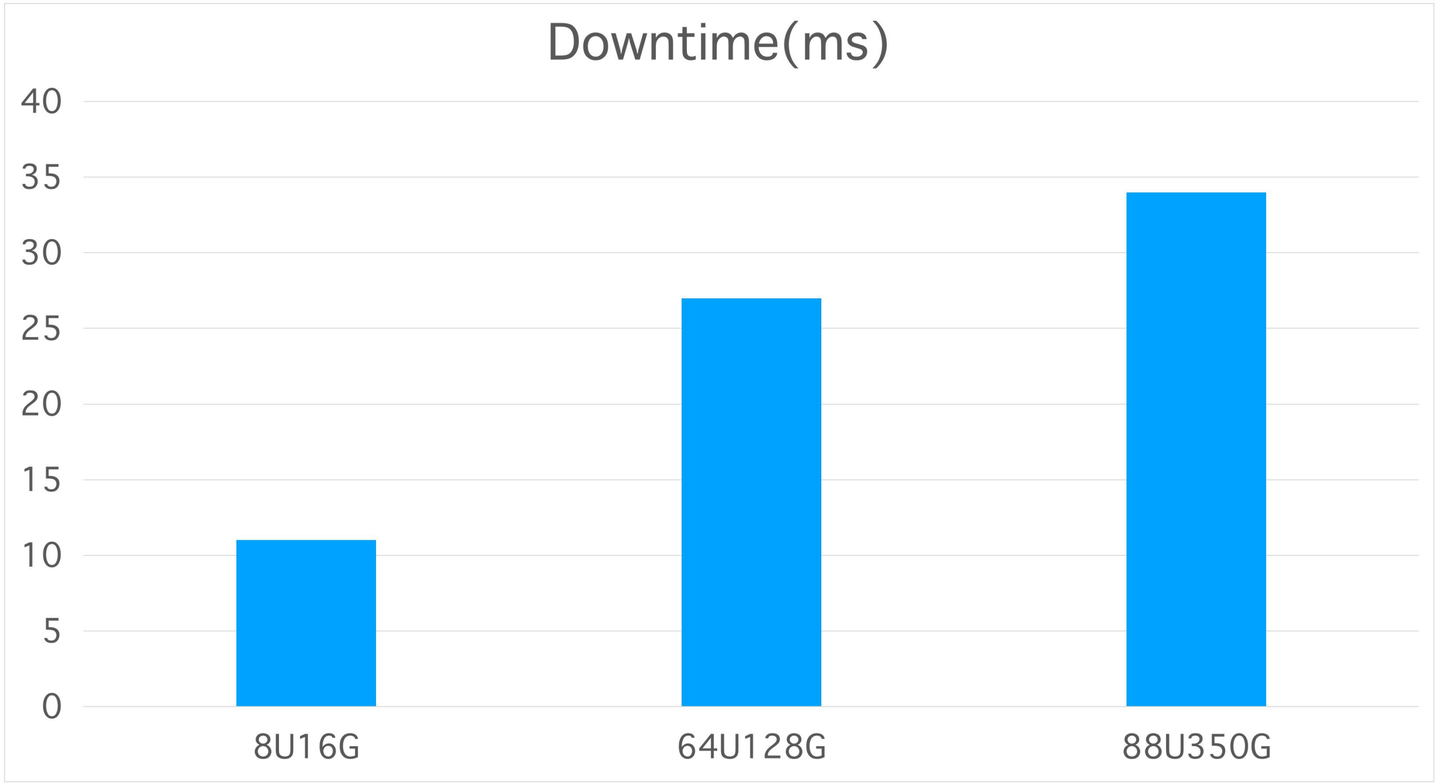
- vcpu downtime: 12ms ~ 34ms



Downtime

VM Workload: memtester 4G

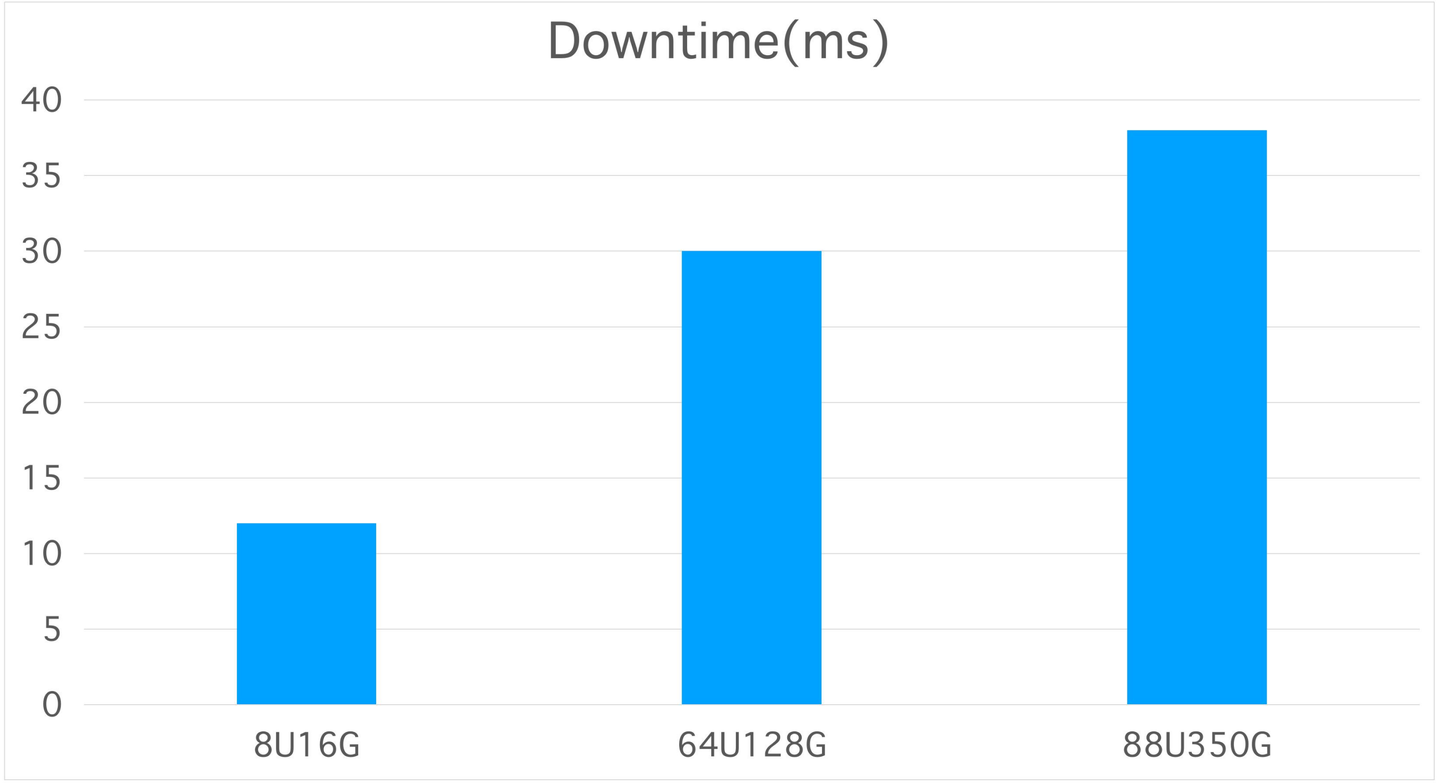
- vcpu downtime: 12ms ~ 34ms



Downtime

VM Workload: fio --filename=/mnt/test.data --iodepth=1 --rw=randwrite --bs=4k --size=40G

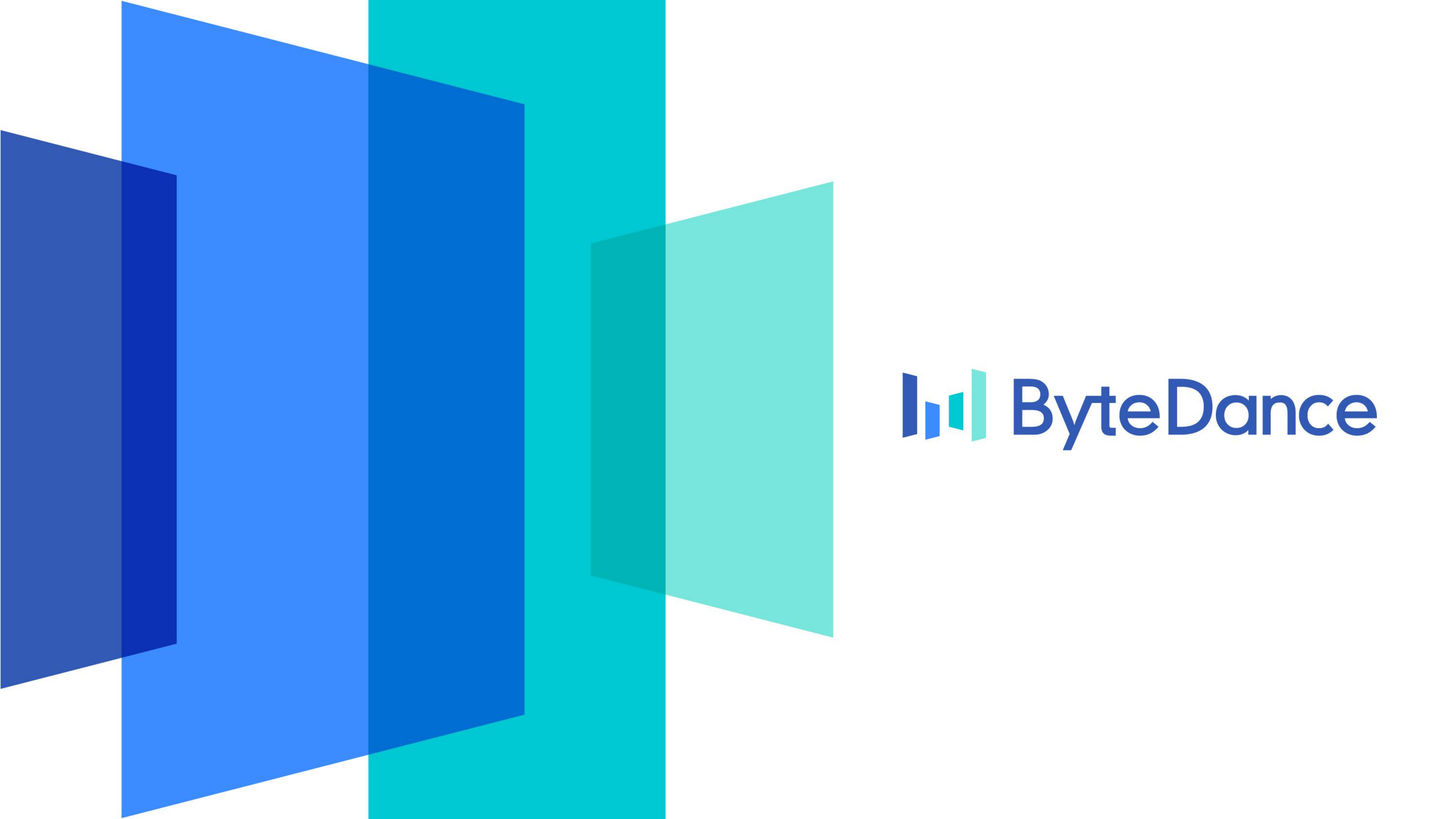
- vcpu downtime: 12ms ~ 38ms



Thank You

Contact Info： fengzhimin@bytedance.com

ByteDance


ByteDance