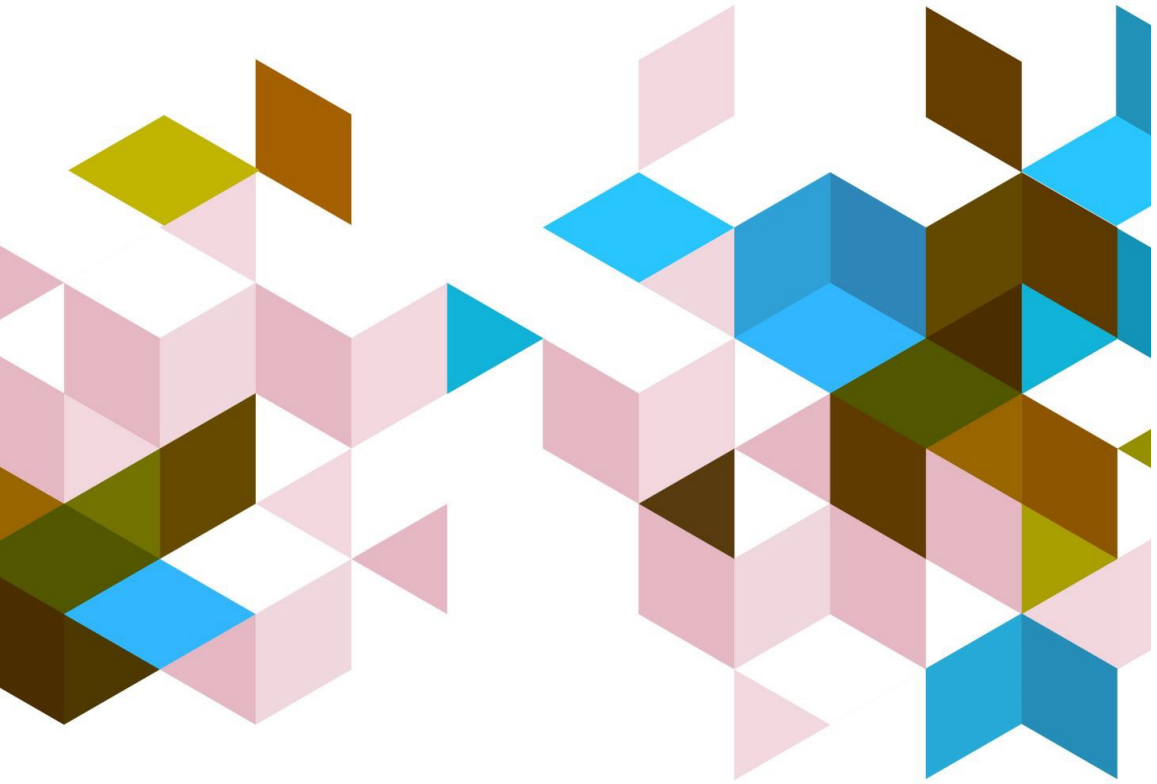

Virtual Machine Migration and Its Applications

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National Tsing Hua University

Feb 22 @ NYU

Outline

VM migration

Applications

What is a VM migration?

- Moving a VM from one physical machine to another one
- Cold migration: VM stops to execute any currently working program and copy the current states to the machine where the VM migrates.
- Live migration: During the migration process, the execution in VM might go on without stopping the execution of programs.

What to migrate?

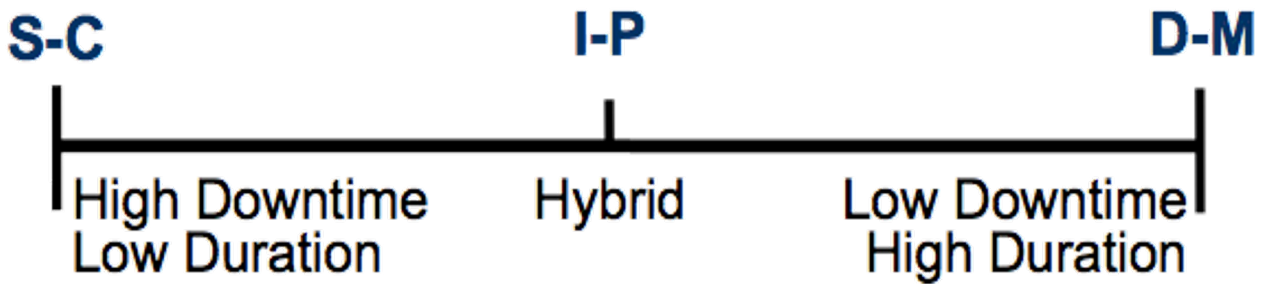
- The VM status needs be moved to new physical machine
  - Register, memory, harddisk, …
  - Data in cache are usually flushed before migration
  - Data in harddisk may not be attached to the physical machine
- VM managing information.
- Virtualized hardware info.

Two major metrics

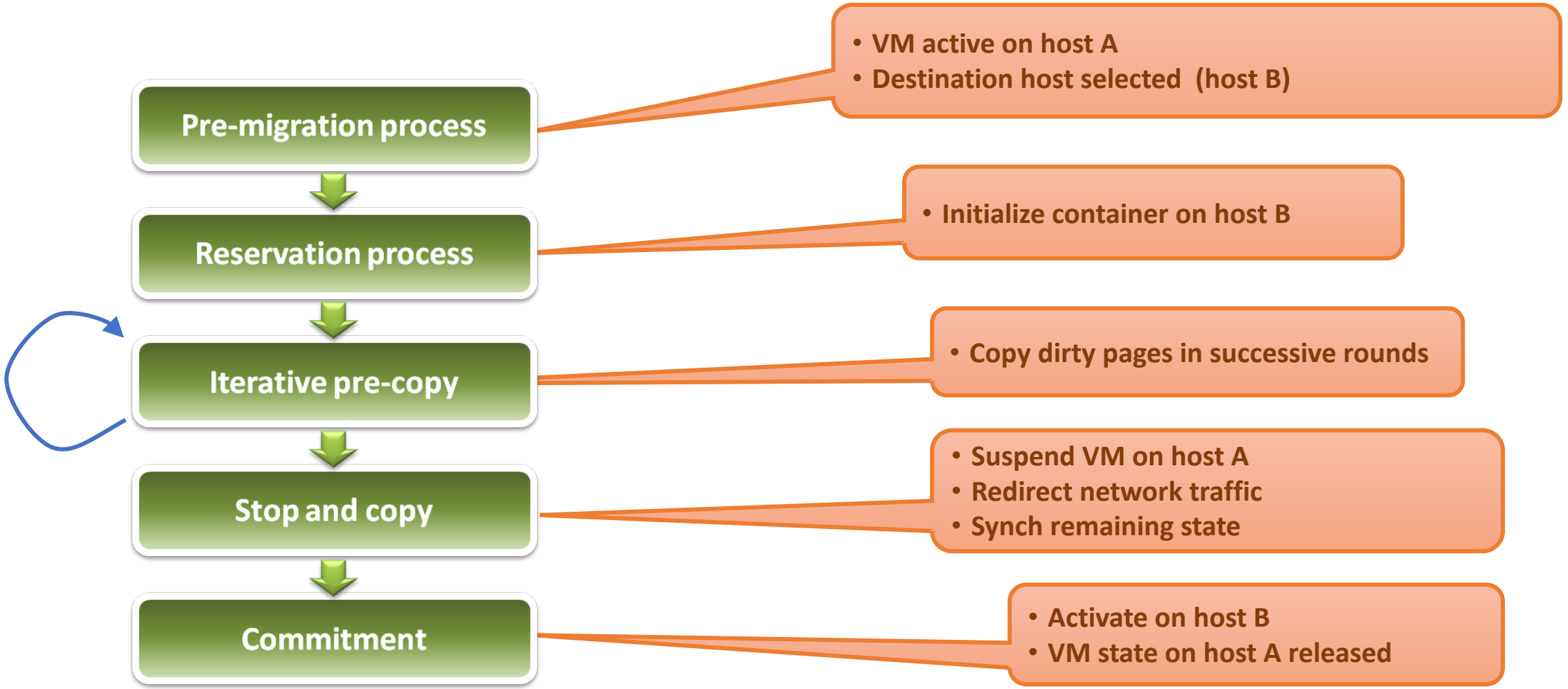
- **Downtime**: the period during which the service is unavailable due to there being no currently executing instance of the VM
  - This period will be directly visible to clients of the VM as service interruption.
- **Total migration time (duration)**: the duration between when migration is initiated and when the original VM may be finally discarded.
  - The source host may potentially be taken down for maintenance, upgrade or repair.

Basic methods

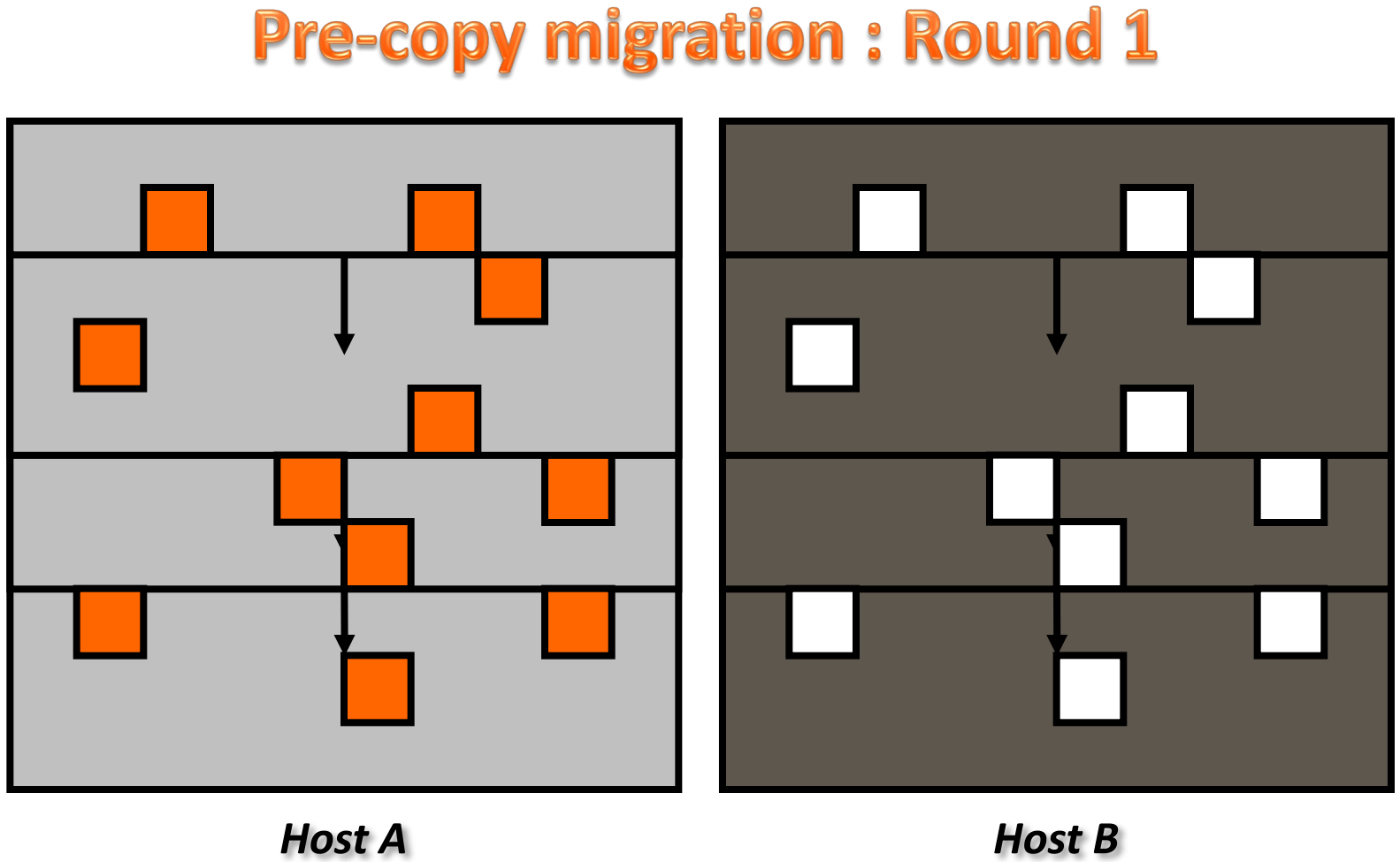
- Stop-and-copy (S-C)
- Demand-migration (D-M)
- Iterative precopy (I-P)



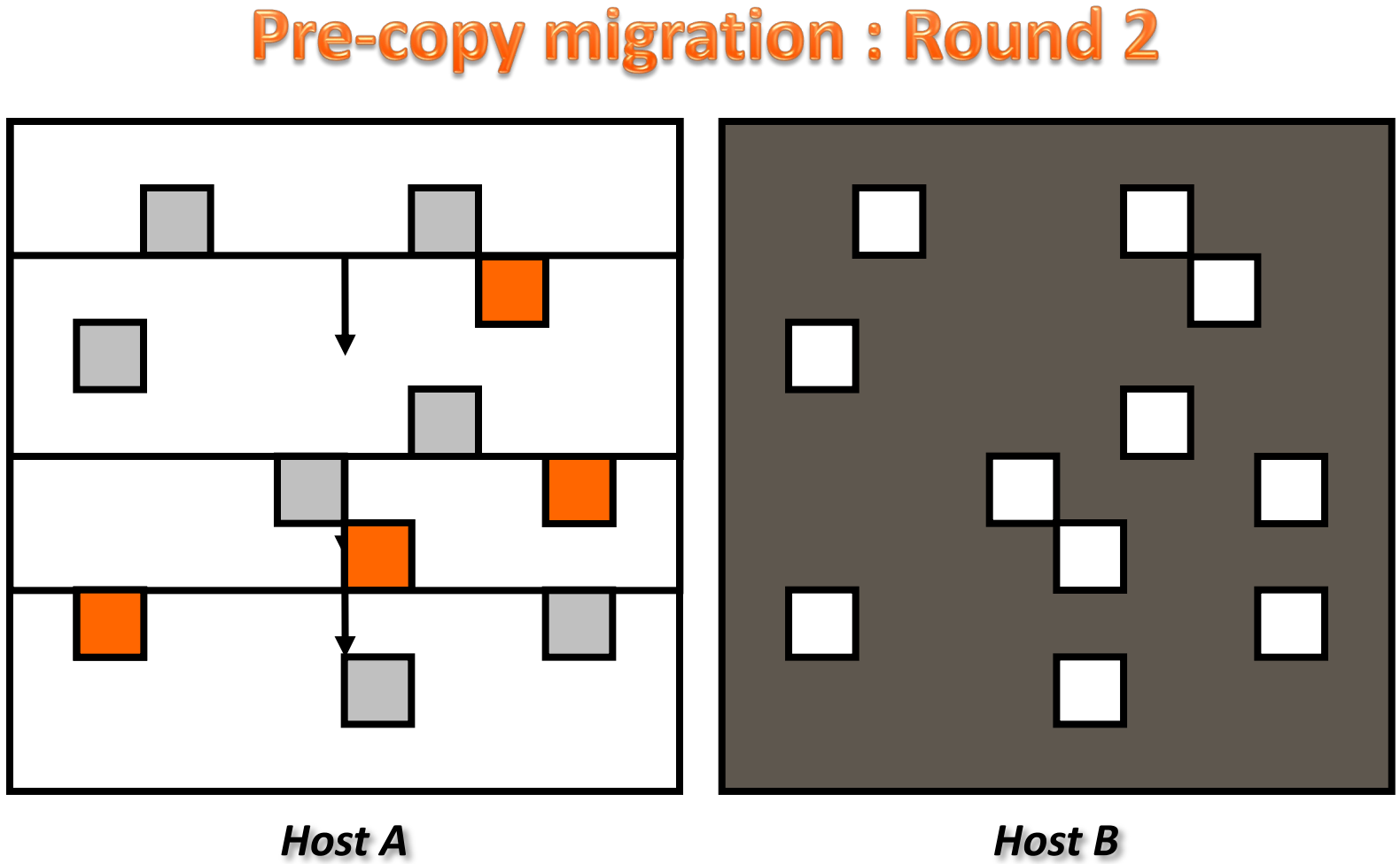
Live migration



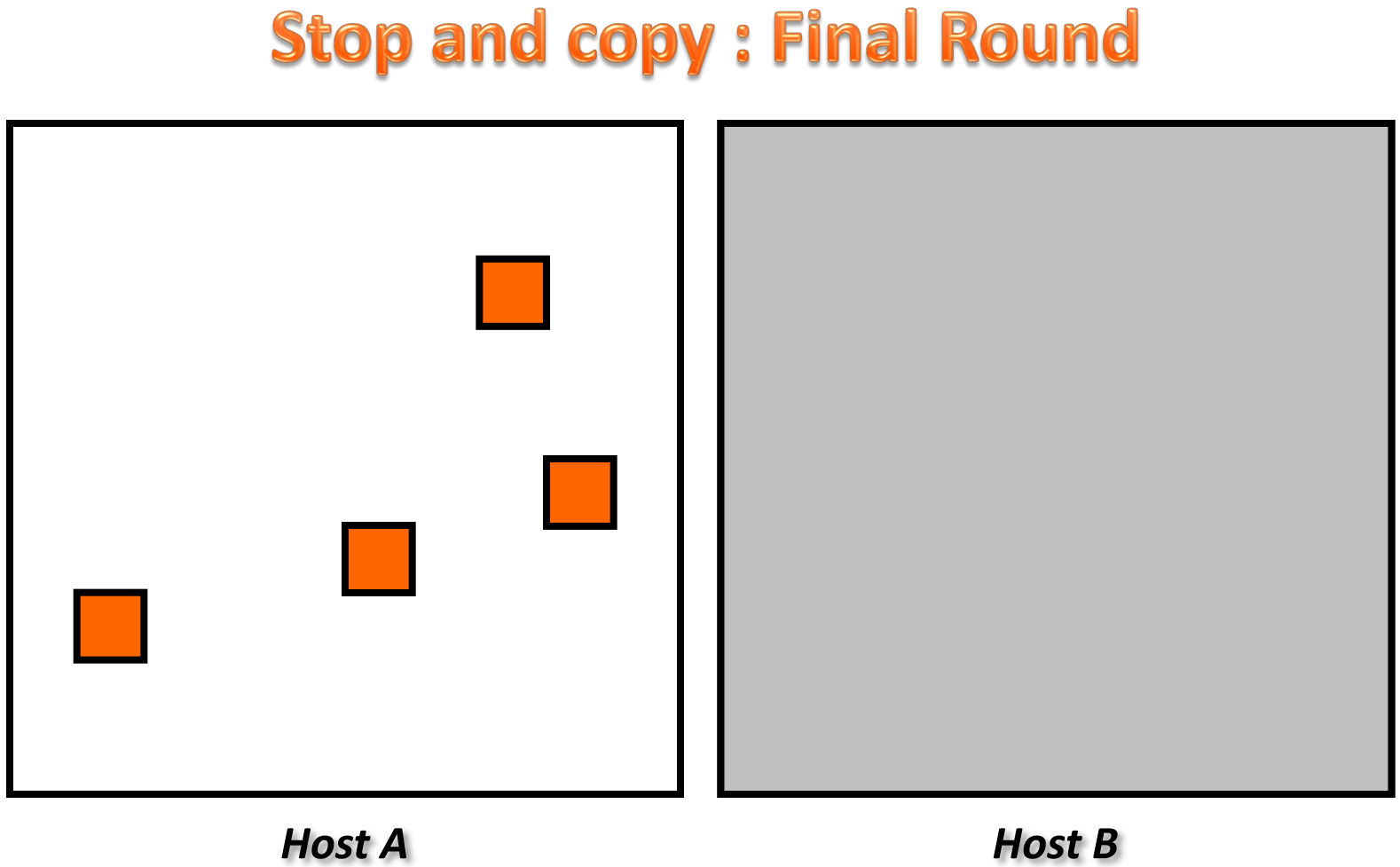
Example: Live migration



Example: Live migration



Example: Live migration

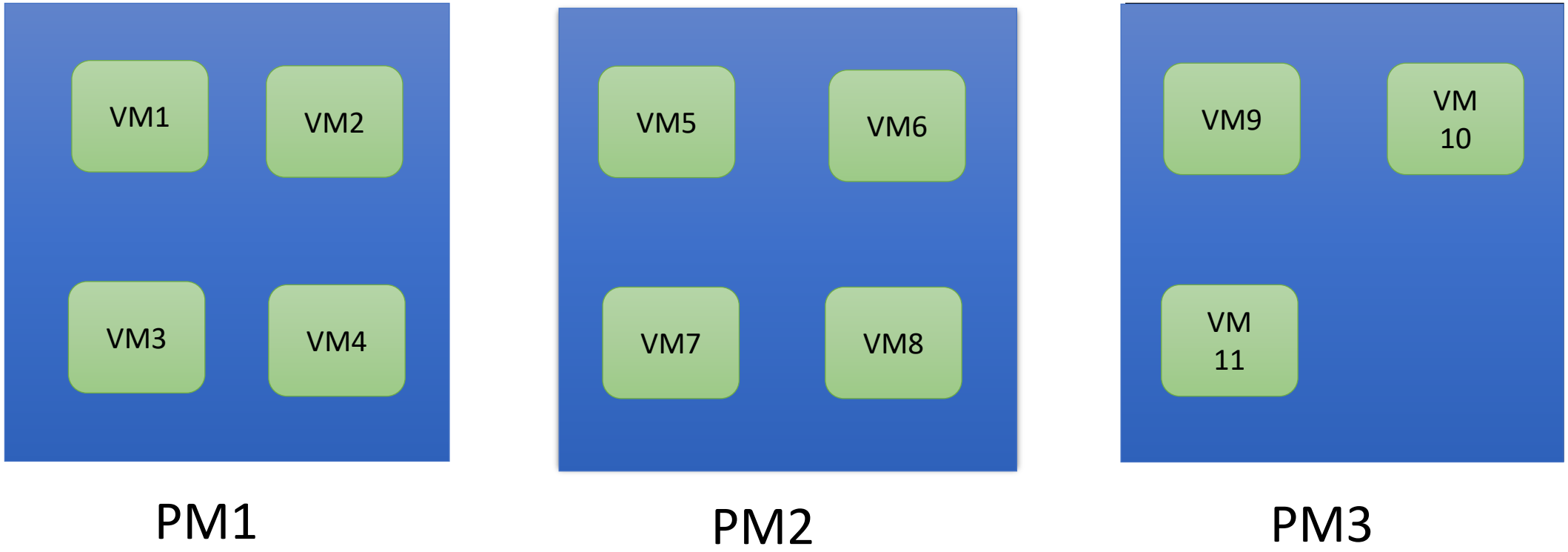


Applications of VM migrations

Why VM migration?

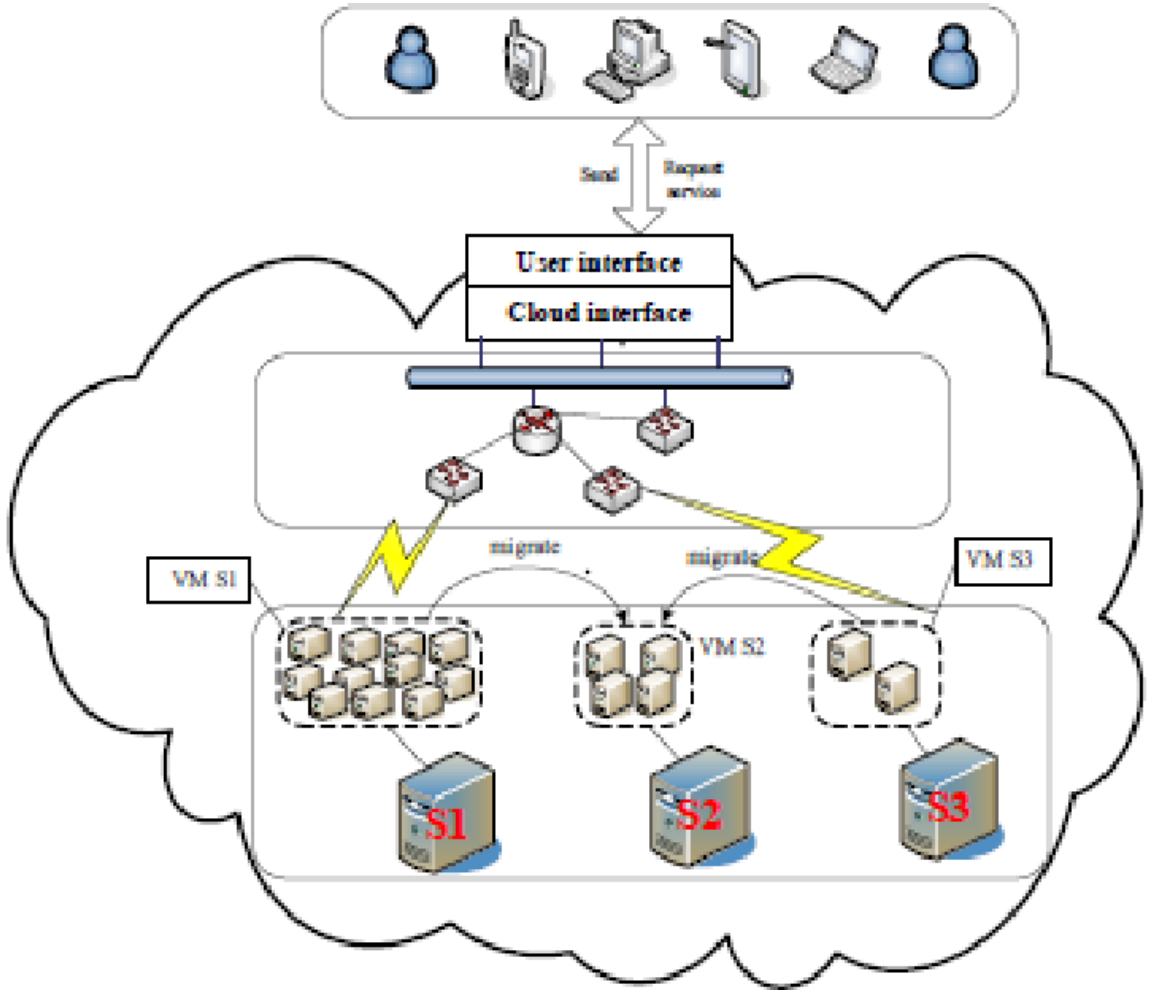
- Resource consolidate
- Dynamic load balance
- Task remapping
- System maintenance
- Fault tolerance (High availability)

VM consolidation



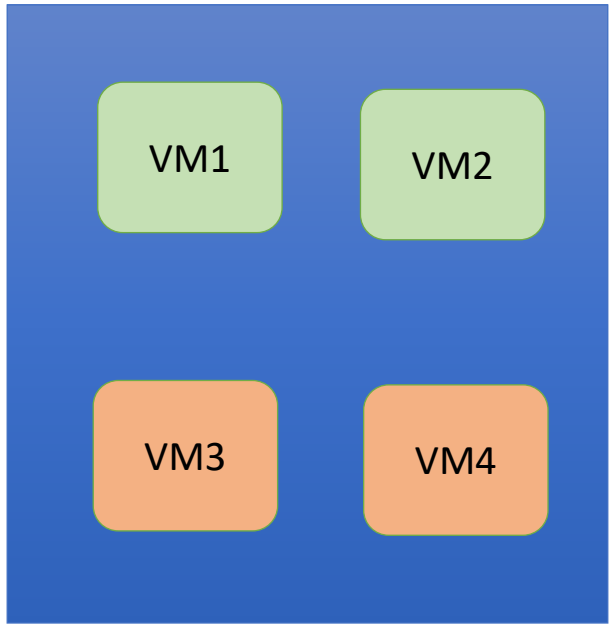
Dynamic load balance

- The load may be changed during the execution of parallel programs.
  - It is hard to re-distributed the workload during the program execution.
- Migrate the VMs to re-distribute the workload.

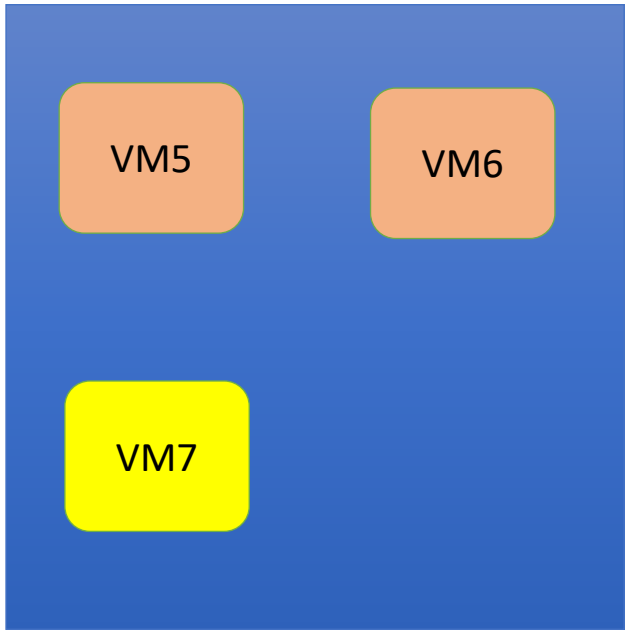


Task remapping

- The communication among VMs within a node is much faster than that of VMs between nodes.
- Ex: Suppose VMs of the same color communicate to each other frequently.



PM1



PM2

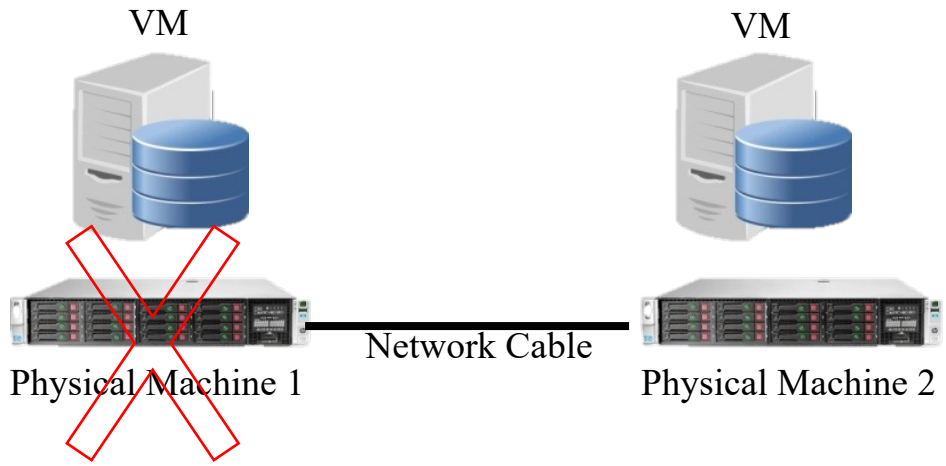
Server maintenance

- In cloud computing, people expect long running and non-stopping services.
  - High availability
- But servers (host machines) need maintenance or to be replaced.
  - Without VMs, services may need to be stopped for maintenance.
  - With VMs, before a maintenance, VMs can be migrated to other healthy servers.

Fault tolerance

- Unlike system maintenance, hardware failure are unexpected.
- Only a very short time can migrate a VM from physical machine 1 to physical machine 2.

- Our solution: Cuju
  - Collaborated with ITRI (Industrial Technology and Research Institute)

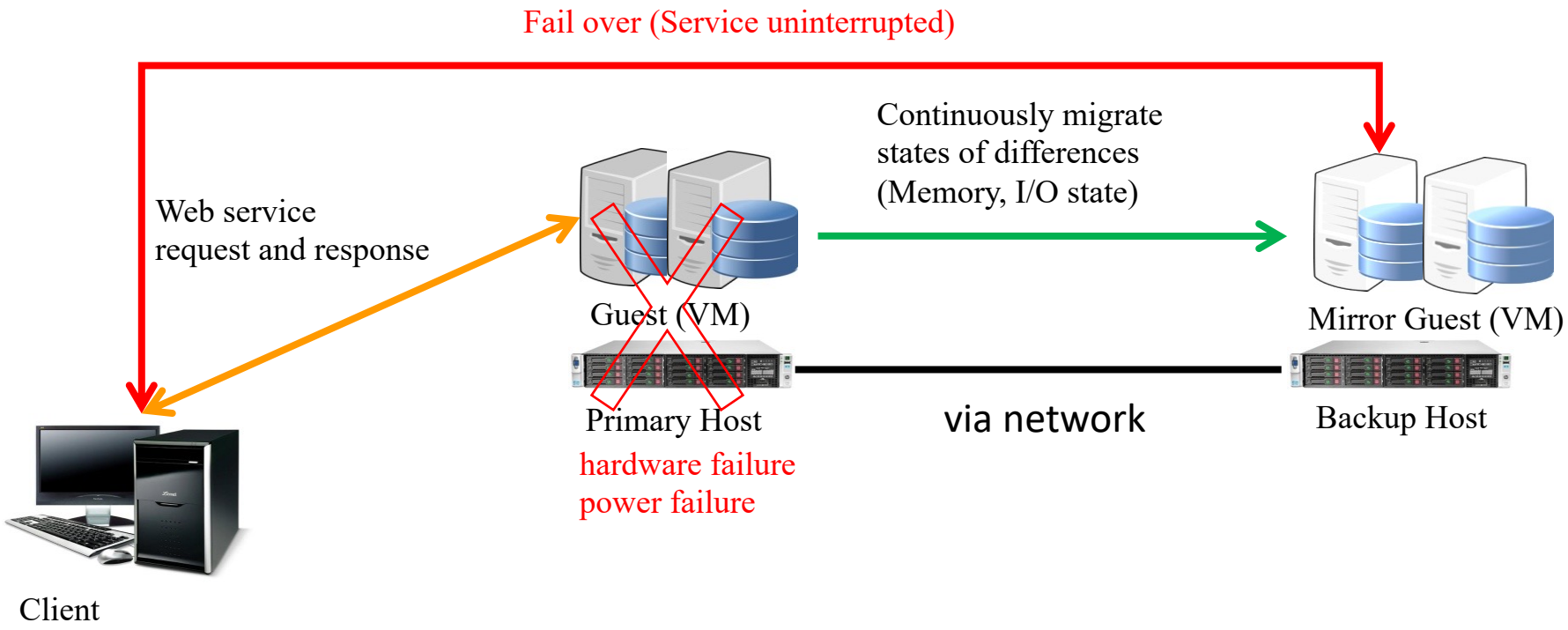


What is Cuju?

- Cuju is an ancient Chinese ball game that players keep a ball non-droppable.
- **Don’t drop the ball!**

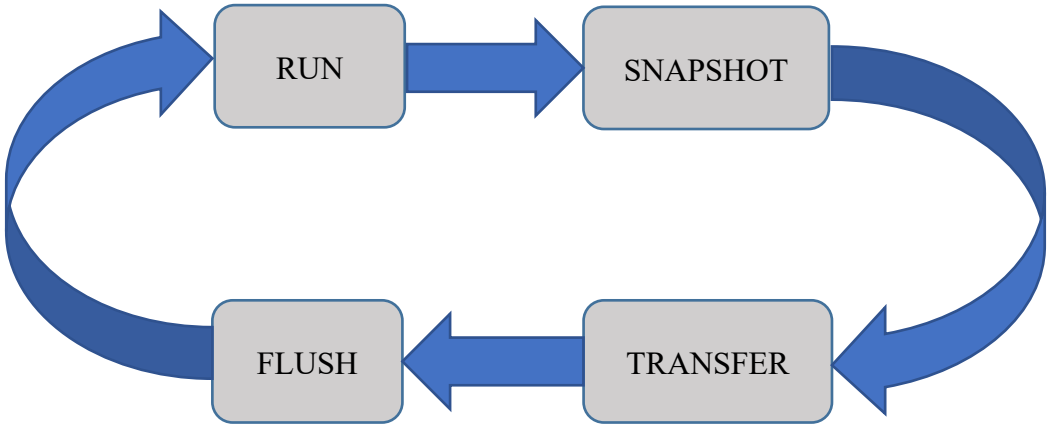
蹴ㄘㄨˋ、鞠ㄐㄩˊ

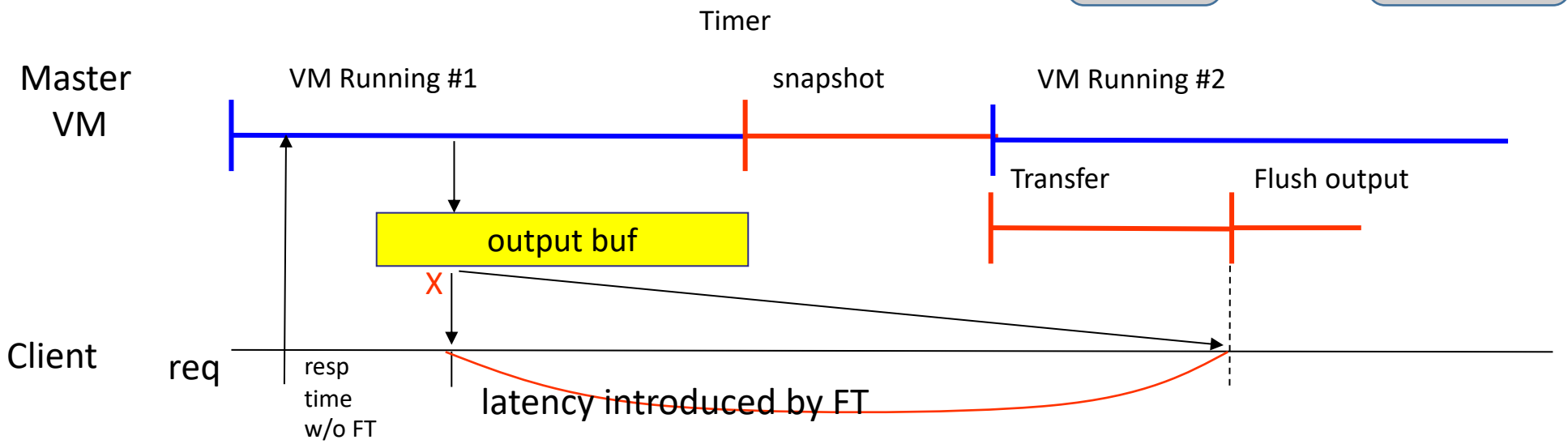
Constantly backup



Epoch-based fault tolerance

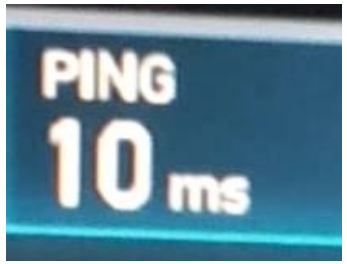
- Need to synchronize client (outside) and Backup side status
  - Release buffer only after the status of Backup side updated





Cuju features

- Cuju is an Open Source Project for Virtualization-based FT
  - Just follow the Install Guide on Github
- The world's only latency can bound to 10ms on Fault Tolerance mode
  - Current hypervisor-based fault tolerance systems all not considered the latency
- Unixbench scores close to VMWare (on FT mode)
  - https://github.com/kdlucas/byte-unixbench



Cuju Webpage
https://cuju-ft.github.io/cuju-web/home.html

Conclusion

- Virtualization is one of the key technologies for cloud computing.
  - On-demand self-service、Rapid elasticity
- Migration techniques help to solve lots of difficult problems
  - Dynamic provision, load balance, task mapping, scheduling, ….
- How to reduce the overhead of VMs and VM migration is still a challenging problem.
  - Container technology
  - Light weight VMs
  - VM templating