# Primary - Backup. (VM-FT)

Motivation

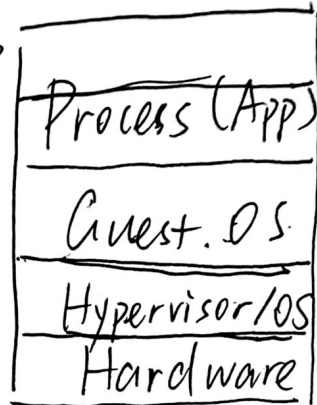Layer

    self-supported

    black-box

VM-FT.

    e.g. GFS Master.

| | |
|---|---|
| GoApp | |
| GoVM | Process (App) — e.g. apache mysql |
| Crane | Guest. OS — linux |
| | Hypervisor/OS — kvm/xen |
| | Hardware — x86 |

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Approach 1.

P  [CPU / Mem]

    ~~states~~
    state cpy ($\Delta$)
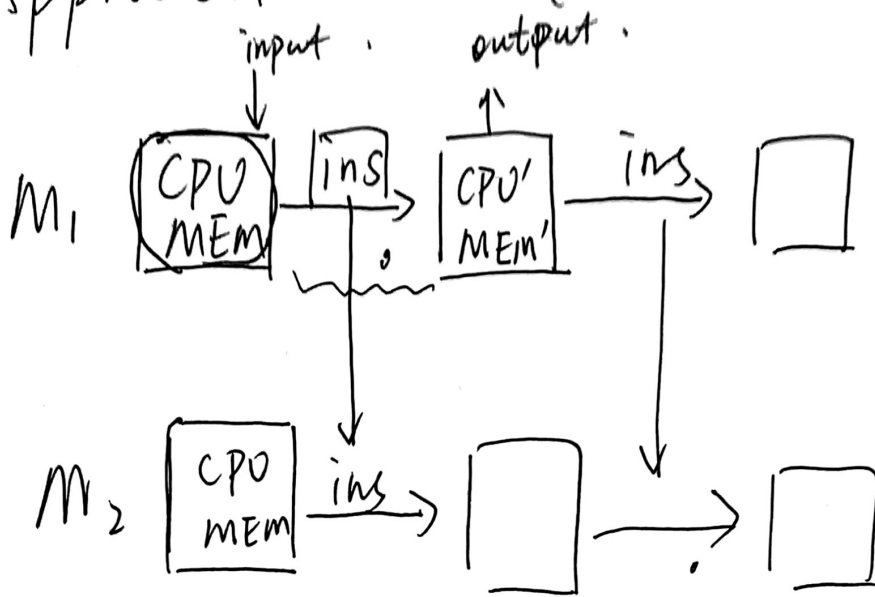
B  [ ]
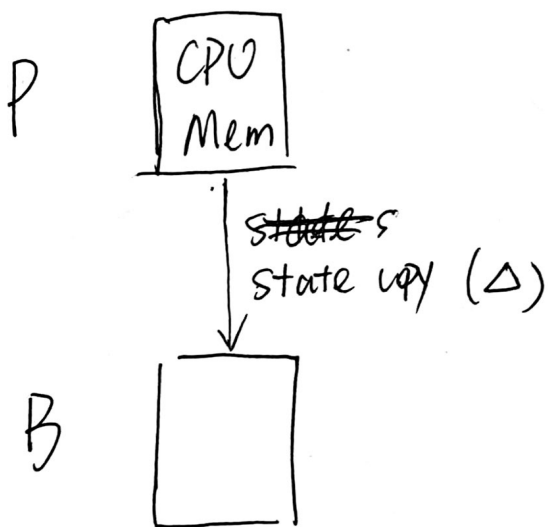
Pro :

    Simple.

Con :

    Slow (Large)

# Approach 2. (State Machine)



Pro : Efficient / transparent.

Con : Harder Imple. { ① DMA.
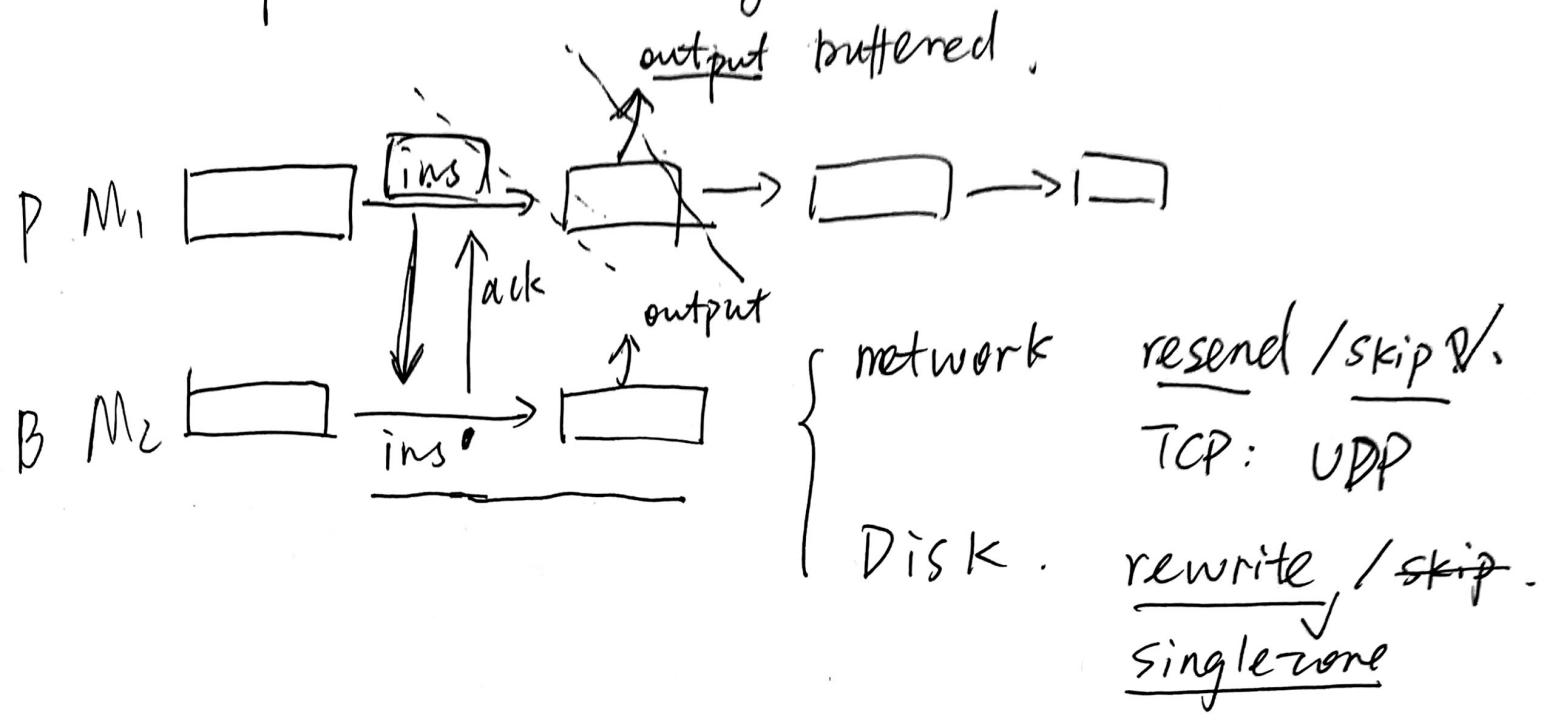② deterministic
③ output consistency

Determinism

clock. (record)

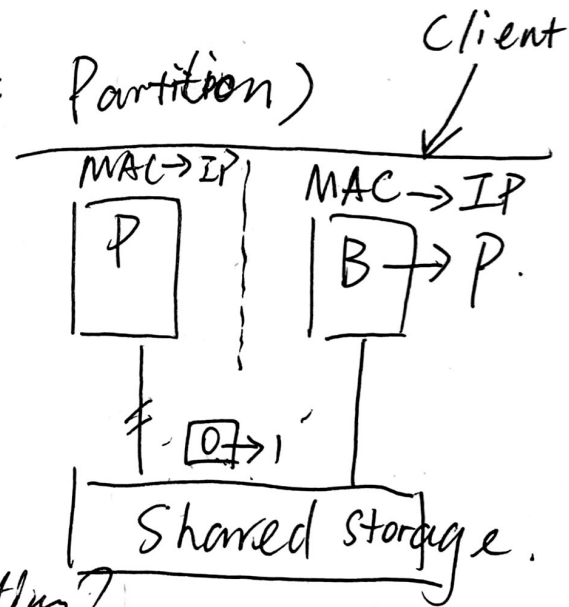DMA   disk / network : Async → Sequential

Multi-core . (No support!)

schedule

# Output Consistency



P M₁ · · · [ins] → ... output buffered ... → □ → □ → □

B M₂ · · · ins' → output

{ network     resend / skip ✗.
              TCP: UDP

  Disk.       rewrite / skip.
              single zone ✓

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" Split - Brain "   (Network Partition)

· Failure Detector.

· Atomic CAS.

· Problem   P loses connection? .

① God. : reset

② Lease.



Client ↓

MAC→IP | MAC→IP
[P]    | [B]⫫P.

⫫ [0]→1
Shared Storage.

P    B    M

grant (60

60 s.

NO, not active

60 s

60 s.

Active

60 s

renewed