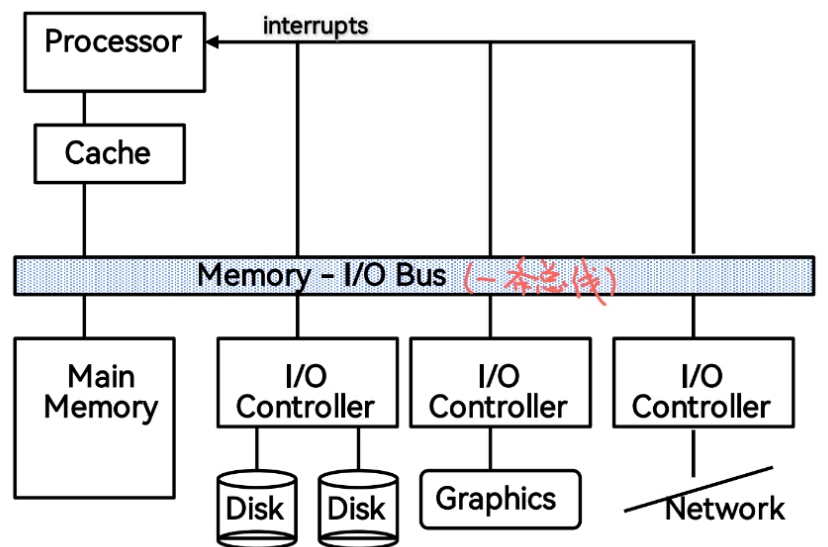
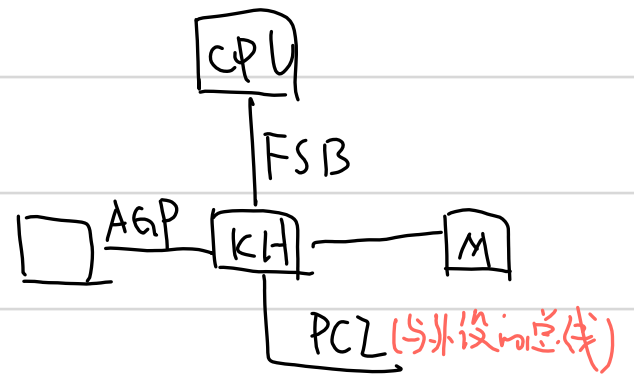
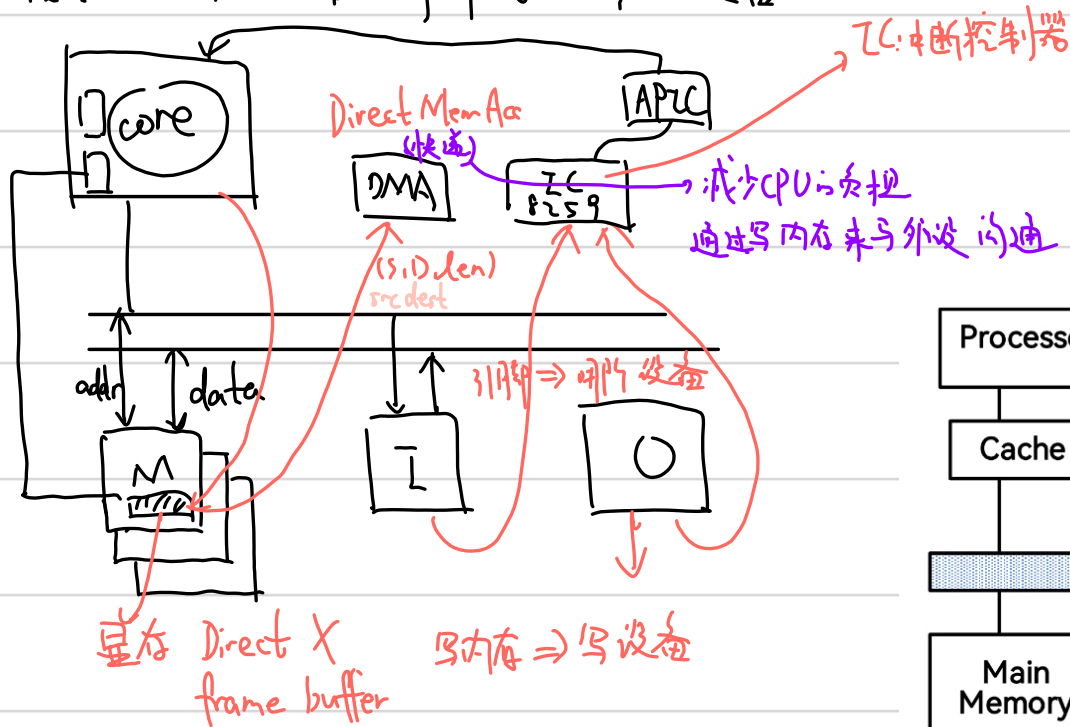


I/O

- I/O vs Mem 发出I/O请求后执行其他任务  
→ 立刻被I/O设备打断
  - I/O too slow: limit system speed-up

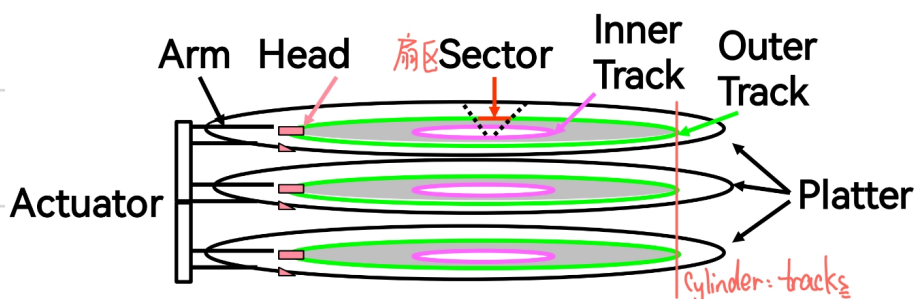
## Async (interruption) Vs Sync (atomic)

- CPU 接收信号, 后通过询问得知 I/O 设备



- Storage (Memory: 512K (CPU, storage: 1T))

→ disk

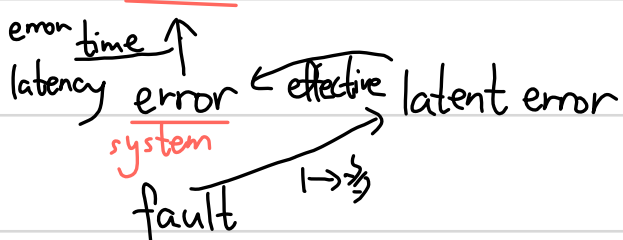


linear vs interleaved

(每12 head 绑定)

- Reliability

→ failure: <sup>service</sup> actual behavior  $\neq$  specified behavior



→ module reliability: Mean Time To Failure

$$\text{Failure rate} = \frac{1}{\text{MTTF}}$$

module availability:  $\frac{MTTF}{MTTF + MTTR}$   $\rightarrow$  Mean Time Between Failure =  $MTTF + MTTR$  improve availability.  
 $\rightarrow$  Mean Time To Repair  $\uparrow \uparrow MTTF$

→ collection of modules:  $\text{FailureRate}_{\text{all}} = \sum \text{Failure Rate} = \sum \frac{N}{\text{MTTF}}$

↑ MTTF  
↓ MTTR