

Distributed Systems

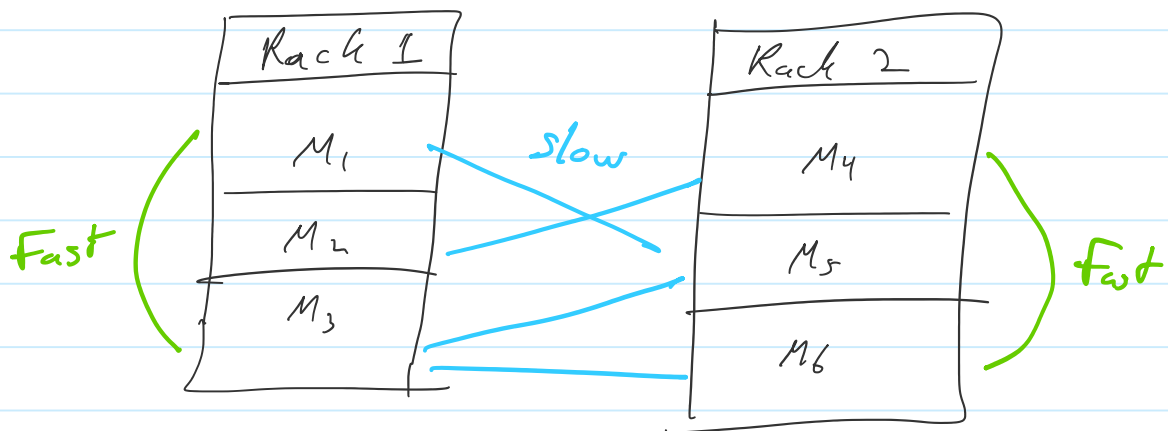
Tuesday, January 10, 2023 7:09 AM

Concepts

Definition

- Collection of independent computers
- Appears as a single coherent system (SSI)

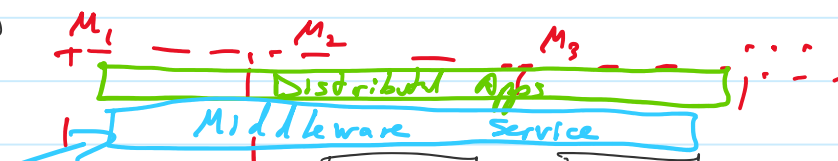
* Unshared: CPU, RAM, Disk, Peripherals, Accelerators, Network Cards, clock

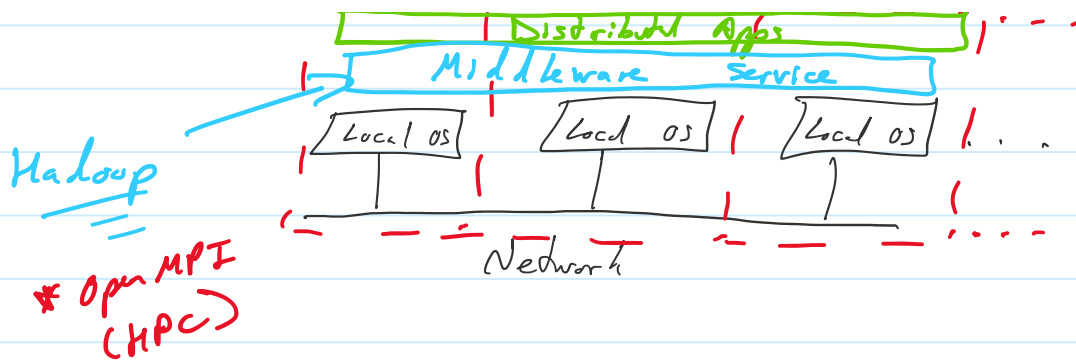


Coherency (Transparency)

- Access
- Location
- Concurrency
- Replication
- Failure
- Mobility
- Performance
- Scaling

* MTBF





Pros/Cons

- Pros

- Price / Perf
- Redundancy
- Parallelization (Large scale) * Open MP
- Extensibility

- Cons

- Reliable system of unreliable components
- Administration / Maintenance
- Data / Code Locality
- Scheduling / Coordination \rightarrow shared state
- Debugging is hard!
- Non-parallelizable tasks

Scalability

- Characteristics

- Increased usage / utilization
 - Increased resource requirements
 - Maintenance / Extensibility
- data analytics
(storage / compute)

- Types

- Vertical : Resources \rightarrow CPU, RAM, ...
- Horizontal : Machines (Nodes) \rightarrow COTS parts / Availability

* Pros / Cons

- Vertical

Pro → Moore's Law

Pro → Multicore + Accelerator

Cons → Backplane Latency & Bandwidth

Cons → Storage (Mem/Disk) Latency & Bandwidth

- Horizontal

Pro → Cost

Pro → Software Maturity

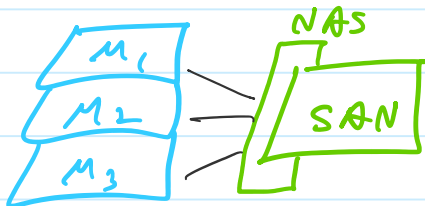
Cons → Complexity

Cons → Consistency (Coherence) **Errors / Fault-Tolerance**

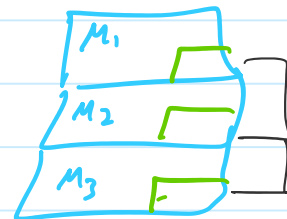
- Storage

• Shared Everything (HPC)

Shared Nothing (Big Data)



PFS = NFS
Lustre
...



DFS = GFS
HDFS

* Mixed-Mode Storage

- Local storage "Scratch"

- Expand Local storage → DFS

- Shared storage → NFS/PFS, Object (S3)

- Cluster

• Distributed System with **Tight Coupling**
- High Speed network (bandwidth, latency)

*** EC2**

- High Speed network (bandwidth, latency)
- Physical Colocation (proximity)

* EC2

* Big Data Clusters

- Traditional HPC \Rightarrow Cluster, CPU Bound

\uparrow
Feed CPU/GPU
w/ data

- Big Data \Rightarrow Cluster, ^(Storage) I/O Bound

\uparrow Feed data
w/ CPU/GPU