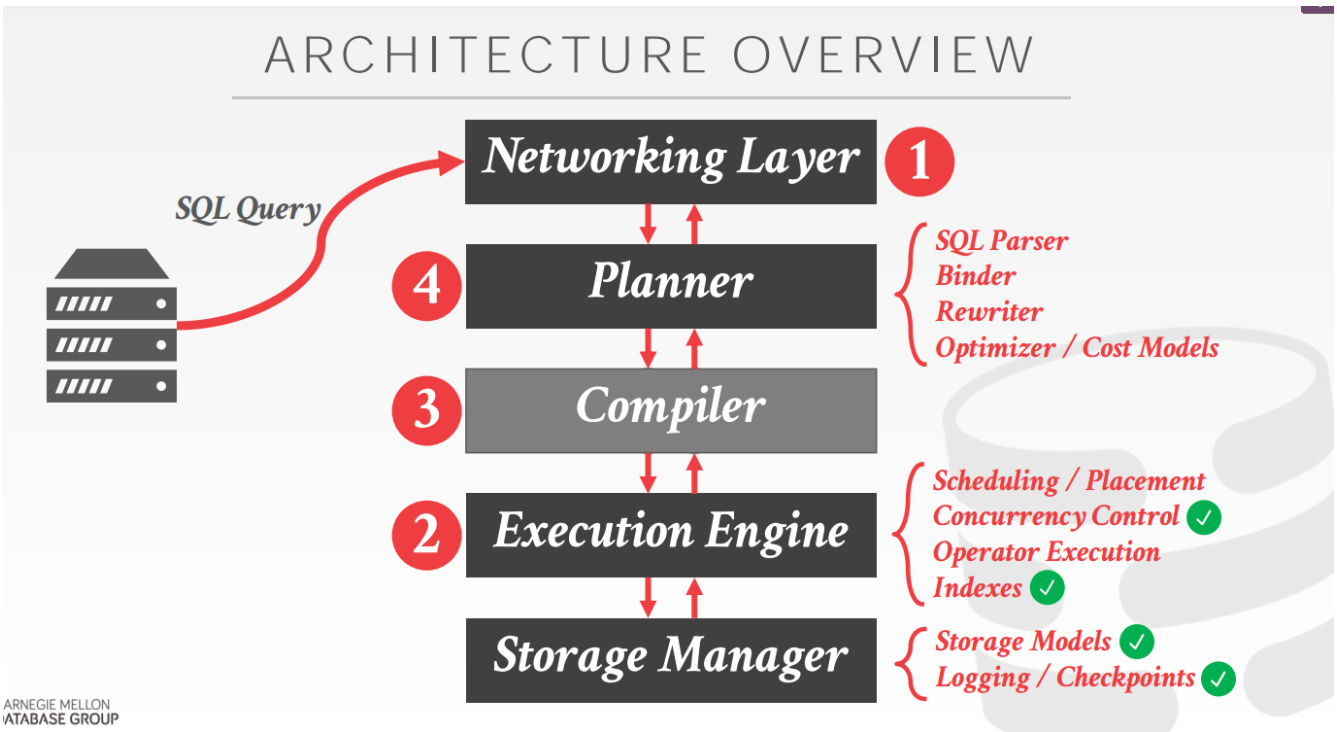
Networking Protocol



上图给出了SQL执行过程中的经过的架构总结

- Networking Layer
- Planner

SQL Parser -> Binder -> Rewriter -> Optimizer / Cost Models

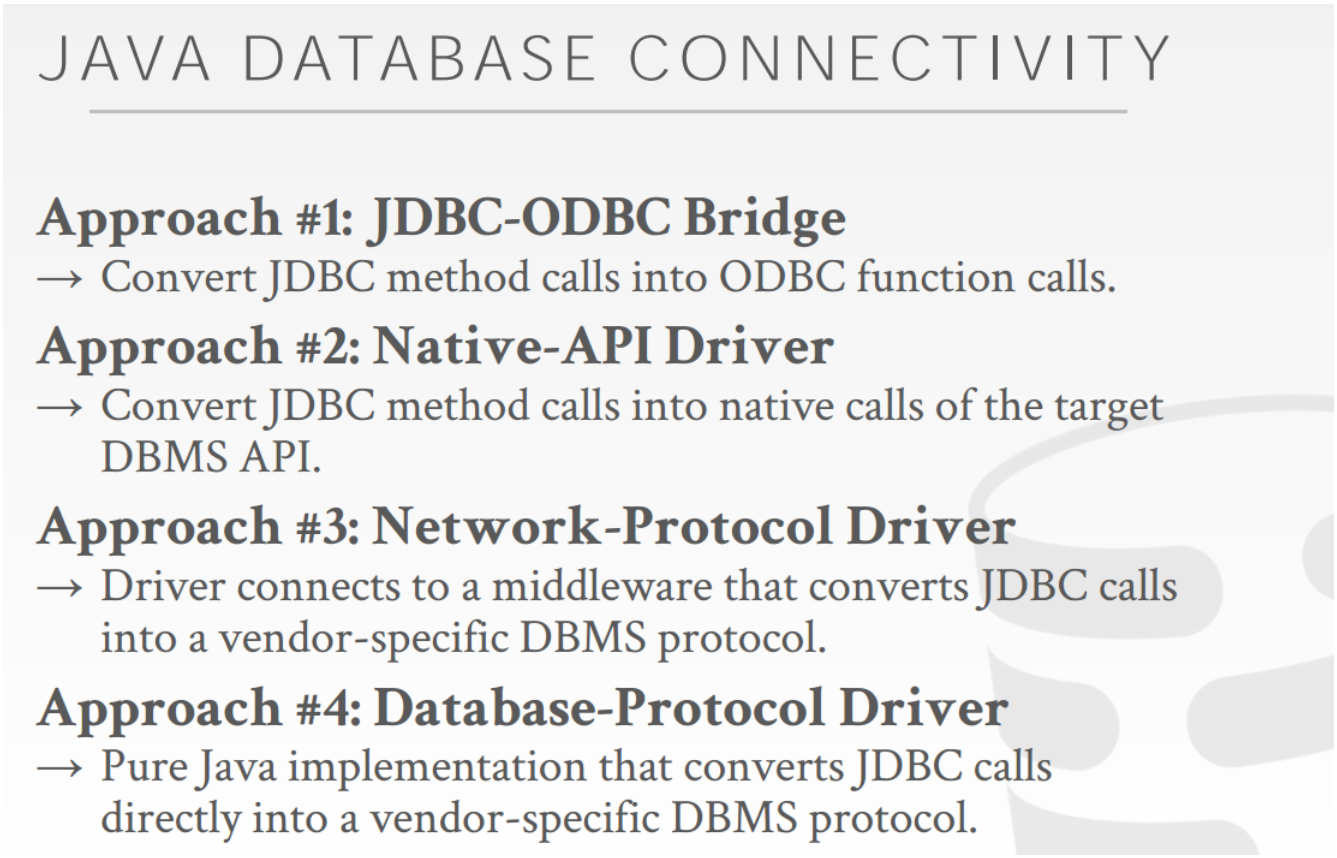
- Compiler
- Execution Engine

Scheduling/Placement ,Concurrency Control , Operator Execution ,Indexes

- Storage Manager

Storage Models/Logging/Checkpoint

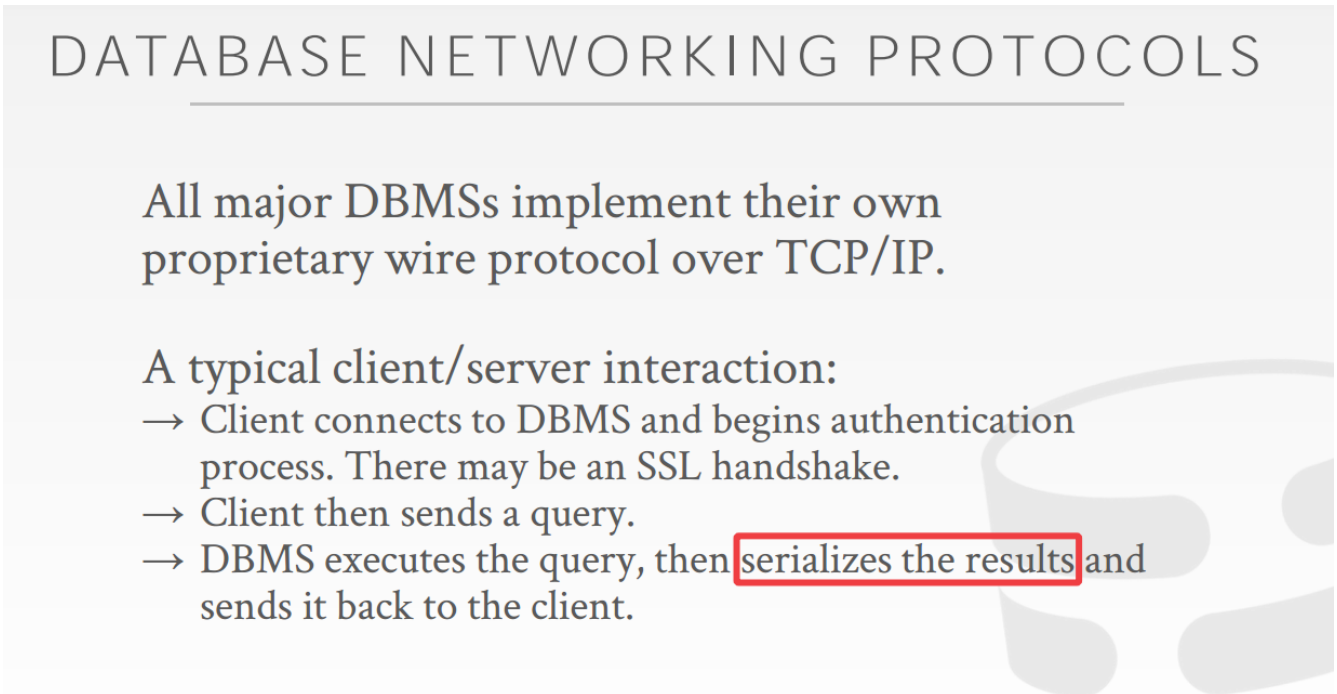
JDBC



第四种效率最高，用语言本身实现原生的Driver

Networking Protocols

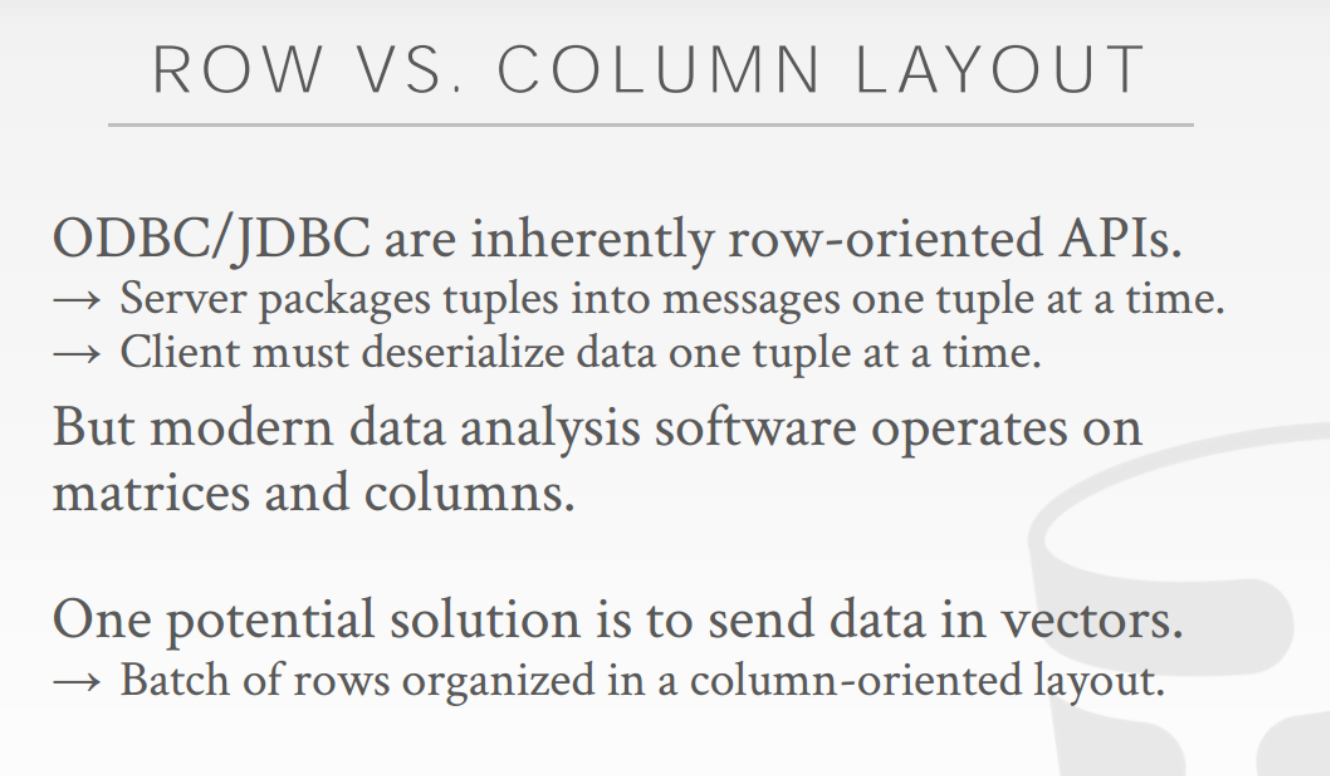
- All DBMS implement wire protocol based on TCP/IP



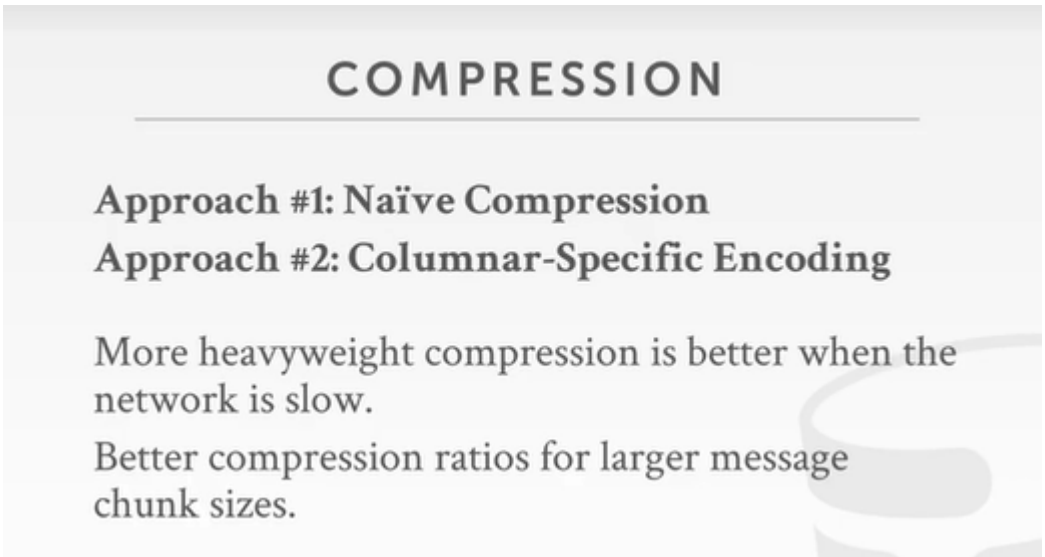
我们的关注点在于序列化反序列化，这也是性能优化的着重点。

- 设计要点

Row/Column Layout



Compression



Data Serialization

- Approach1: Binary Encoding

eg: ProtoBuf

Client handles endian conversion.

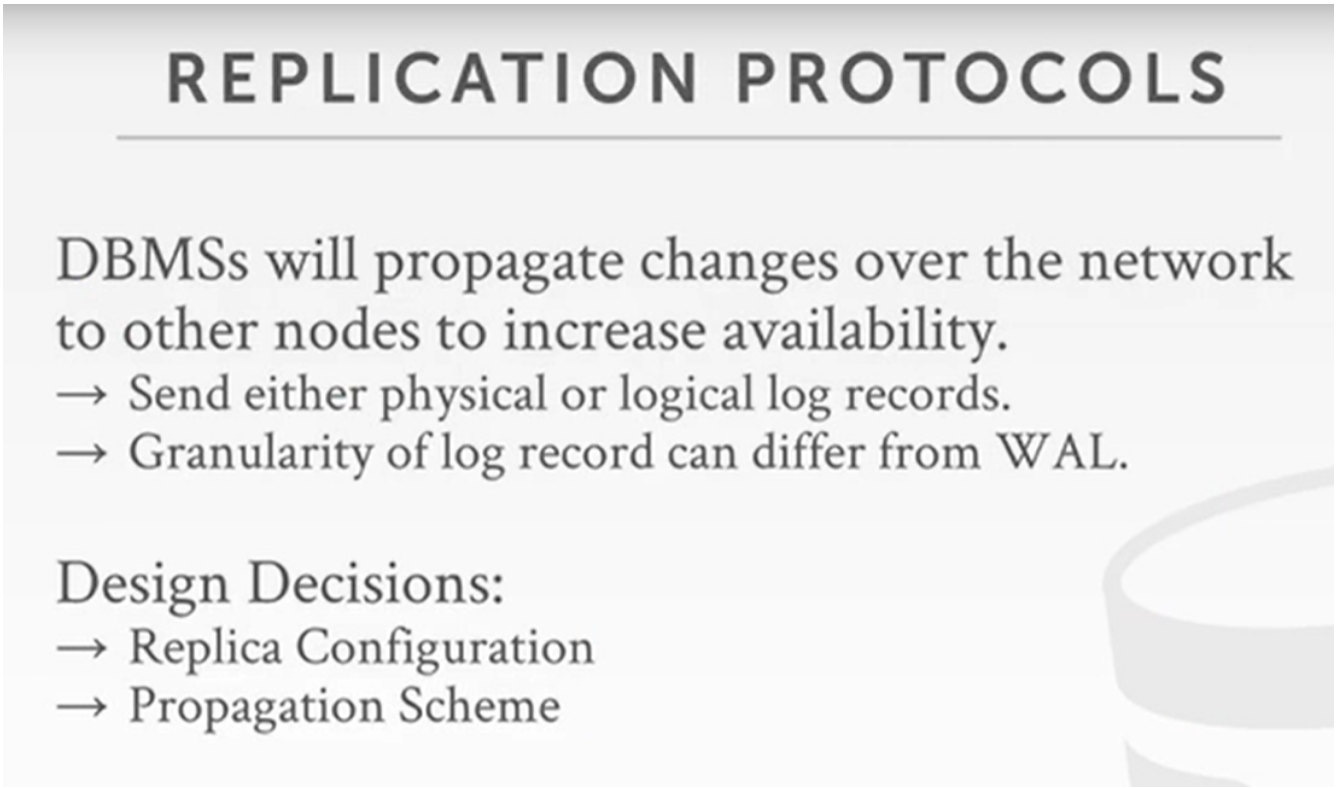
You also need to store the extra metadata about the show the serialized messages.

可能会导致一条很长的数据，分多次发送，但是元数据是相同的，你要复制传输相同的元数据多次。

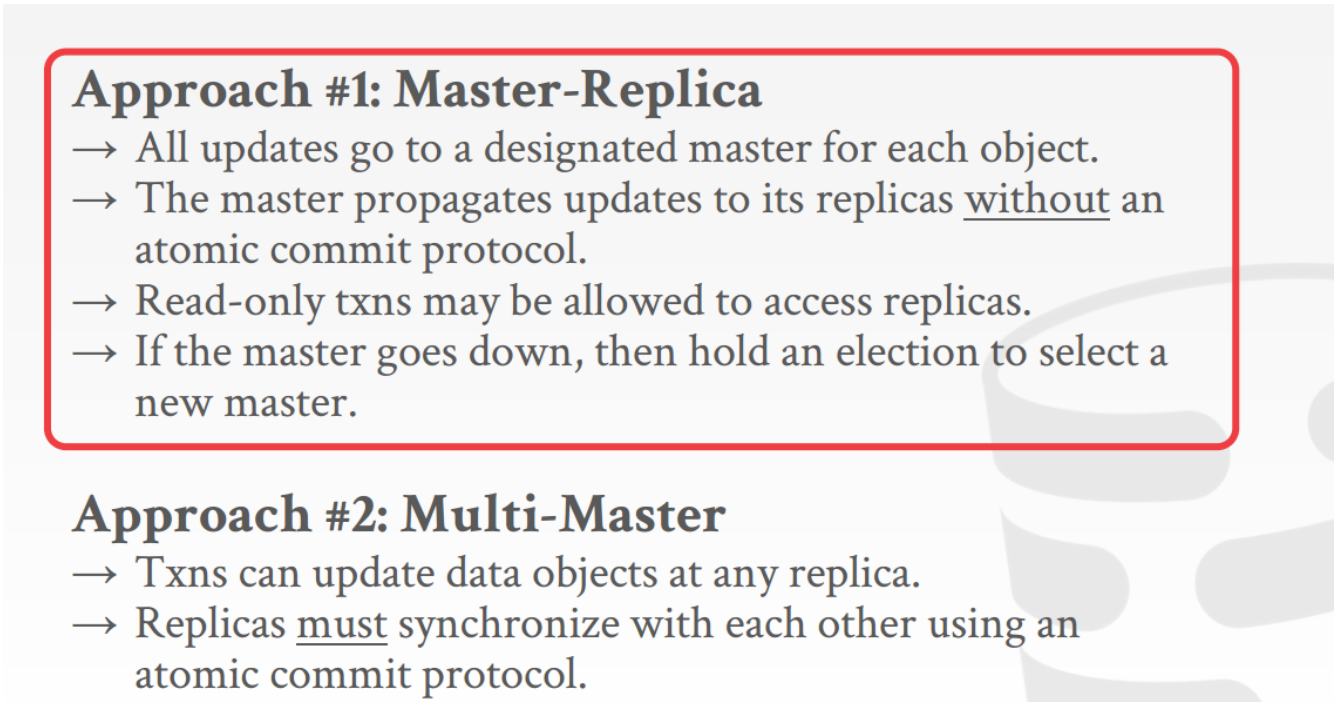
- Approach2: Text Encoding

  Convert all binary values into strings.

不同节点之间的传输：

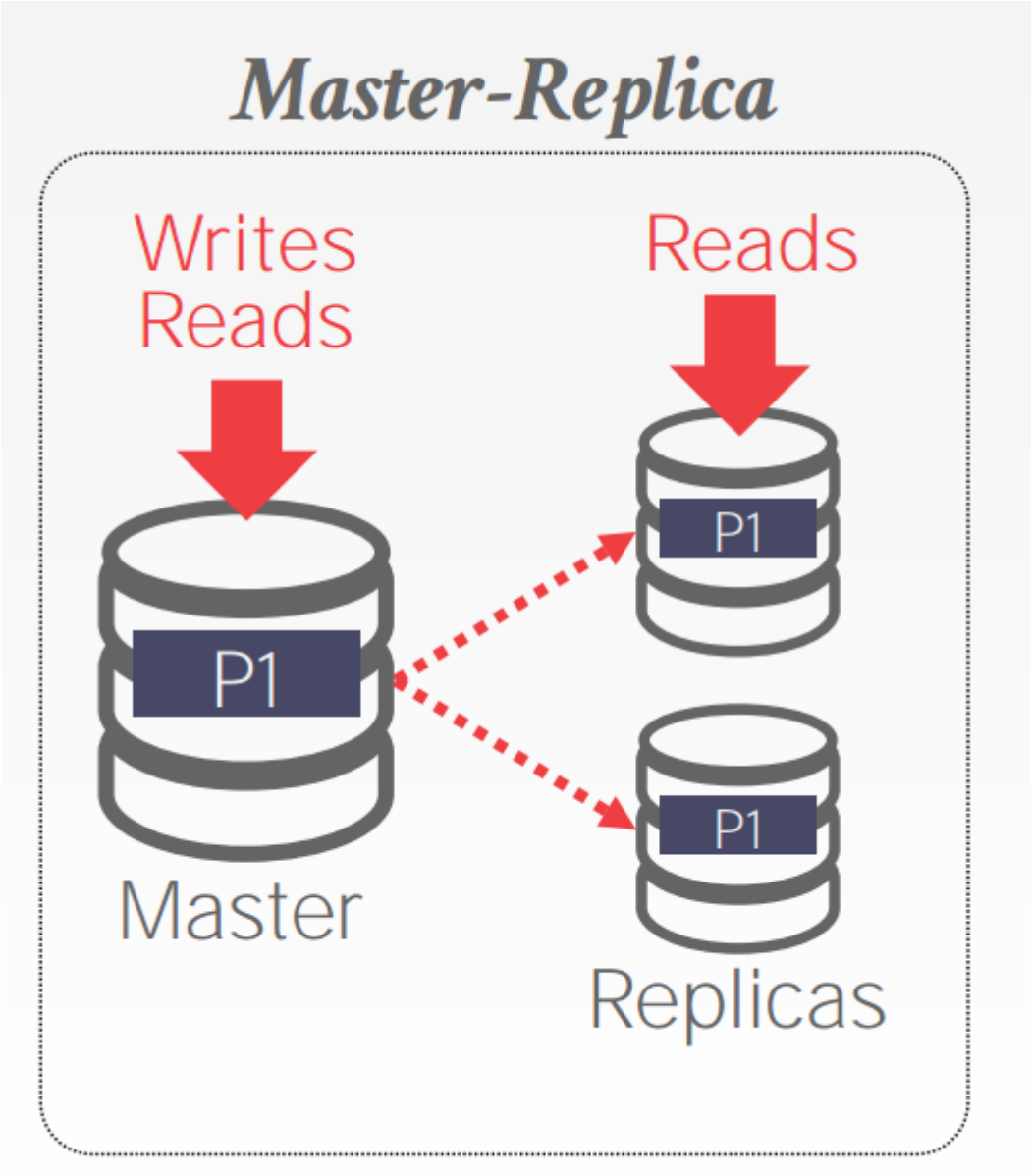


可以分为两种策略：主从型和多主型

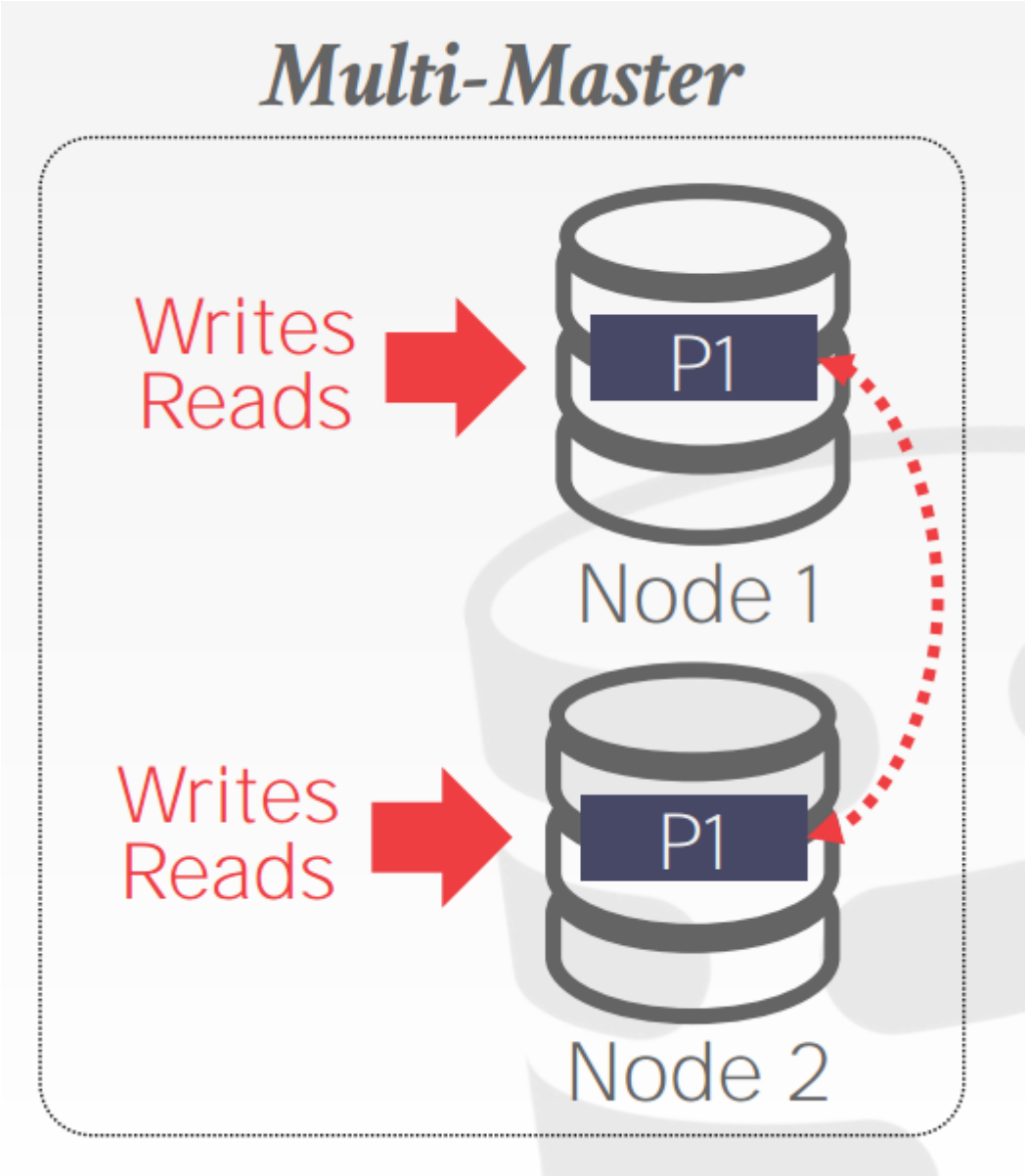


主从型：

主写读从，主节点不需要通过原子提交协议与从节点做同步



多主型：



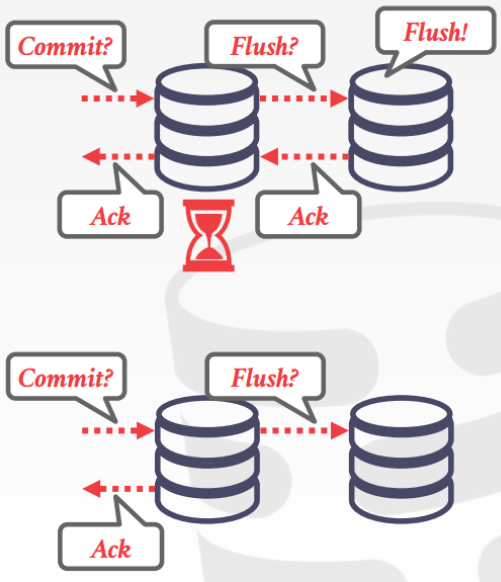
数据同步策略也可以分为同步与异步两种:

Approach #1: Synchronous

→ The master sends updates to replicas and then waits for them to acknowledge that they fully applied (i.e., logged) the changes.

Approach #2: Asynchronous

→ The master immediately returns the acknowledgement to the client without waiting for replicas to apply the changes.



- 同步：主节点同步到副本的时候，必须保证副本数据落盘并且返回ack给主节点，当主节点收到所有的ack之后就可以向客户端返回事务提交成功的通知。
- 异步：类比于Kafka的In-sync Replica机制，不需要等待副本落盘之后并返回ack

但其实DBMS的network protocol并不是制约其性能的原因之一，TCP/IP协议栈其实也很慢：

- 上下文切换/中断代价高
- 数据复制开销大
- 内核代码中latch很多

解决方法：

Kernel Bypass Methods

直接从网卡拿数据，避免数据拷贝和OS TCP/IP 栈

- Approach1:

DPDK(Data Plane Development Kit)

1.消除Data复制开销/系统调用开销

2.直接从网卡拿数据

- Approach2:

RDMA(Remote Ditect Memory Access)

直接从远程host根据地址获取memory的内容