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CockroachDB 2.x特性详解

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PART 01

CockroachDB 介绍

Release Timeline

14年Github开源，17 年Release 1.0，目前版本2.1.6，即将release 19.1

1.0 — 2017.5.10

- DistSQL
- Online DDL
- Multi-Active
- Cloud Native

…

1.1 — 2017.10.12

- 支持滚动升级
- 支持import/dump
- Show/Cancel Query

…

2.0 — 2018.4.4

- GEO-Partition
- 支持Backup/Restore
- RBAC
- 支持JSON类型
- 支持SQL审计

…

2.1 — 2018.10.30

- CBO
- Read From Follower
- CDC
- 任意时间点备份恢复
- SQL可视化诊断
- 透明加密

…

PART 02

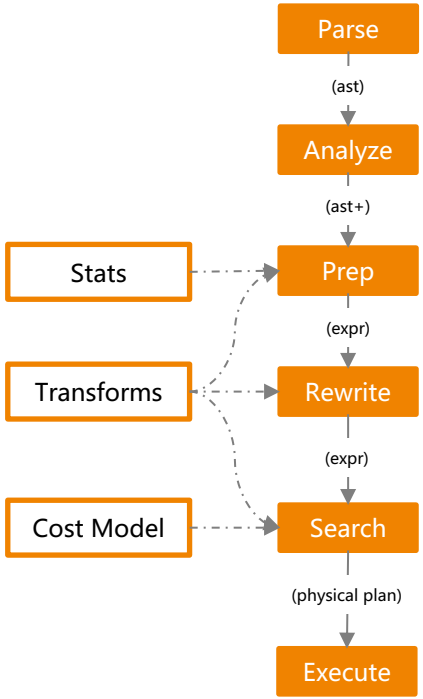
CockroachDB 2.x关键特性

- ✓ Cost Base Optimizer
- ✓ Read From Follower
- ✓ CDC

Cost Base Optimizer

- RBO :
  - ✓ Rule-based Optimizer
  - ✓ 根据通用的确定的优化规则变换重写执行计划
- CBO :
  - ✓ Cost-based Optimizer
  - ✓ 枚举可能的执行计划，计算每个执行计划的COST，最终选择COST最低的执行计划
- Why choose CBO?
  - ✓ RBO只根据静态规则优化执行计划，而CBO可以从时间和资源的角度评估，为每个SQL选择最优的执行计划
  - ✓ 随着优化规则越来越多，RBO添加和修改规则会越来越复杂

CBO——优化过程



- SQL解析
- 语法检查
- …

- 常量展开、类型检查、resolve names
- 语义检查
- …

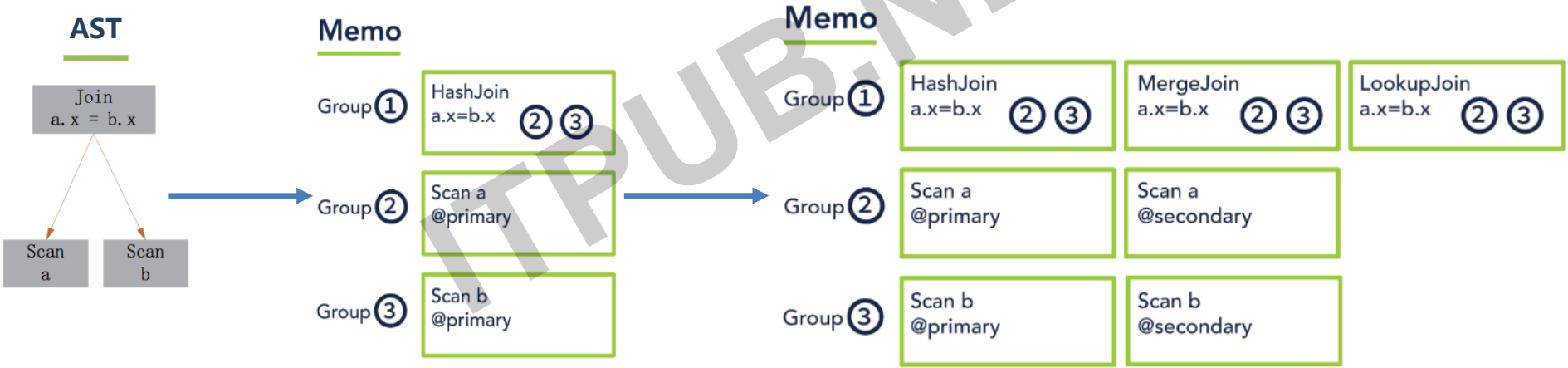
- 把AST变换成Memo expressions tree
- 填充统计信息
- …

- placeholder展开
- 根据规则重写执行计划
- …

- 根据规则产生等价表达式
- 生成执行代价，并查找最小代价的执行路径
  - ✓ Cost of a Expr Tree = Cost of Child Expr + Cost of Parent Expr （自底向上）
- 生成分布式执行计划

CBO——等价表达式管理

【Memo】- 管理查询所有等价计划树
- 跟踪每个Memo group的最低代价
└── Memo Group：一组 **logically equivalent的表达式**
└── Memo Expr：每个Memo表达式拥有一组Memo子表达式



- There are 12 possible plans (3 * 2 * 2) encoded in this memo.

CBO——统计信息生成

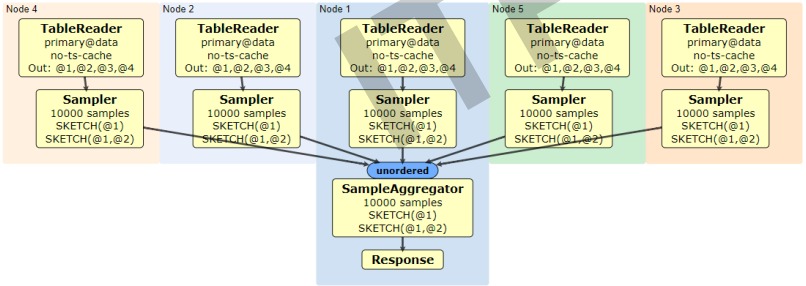
- 目标：供coster使用，计算每个Expr的计算成本（代价）
- 分类
  - Table statistics
    - 从metadata获取
    - 持久化在系统表system.table_statistics
  - Relational expression statistics
    - 从table statistics延伸
    - 仅对某一特定memo group有效
- 自动收集的统计信息

number of rows	number of columns
number of null value	Histogram (data value distribution)

Next Release:

Sketch
Range-level statistic

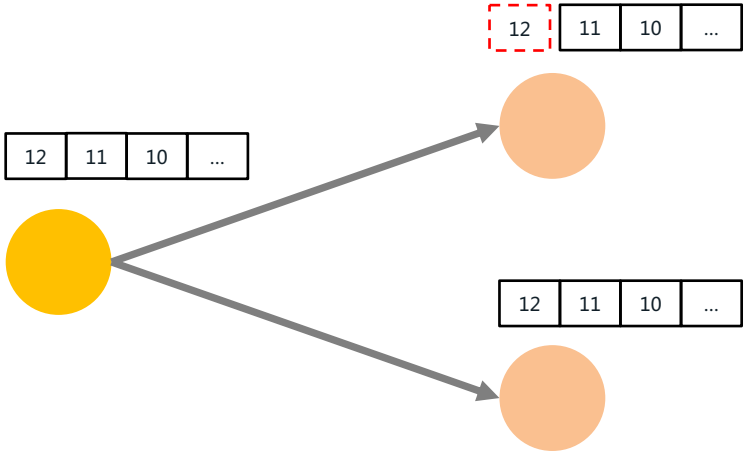
- 如何收集统计信息？



为什么要Read From Follower

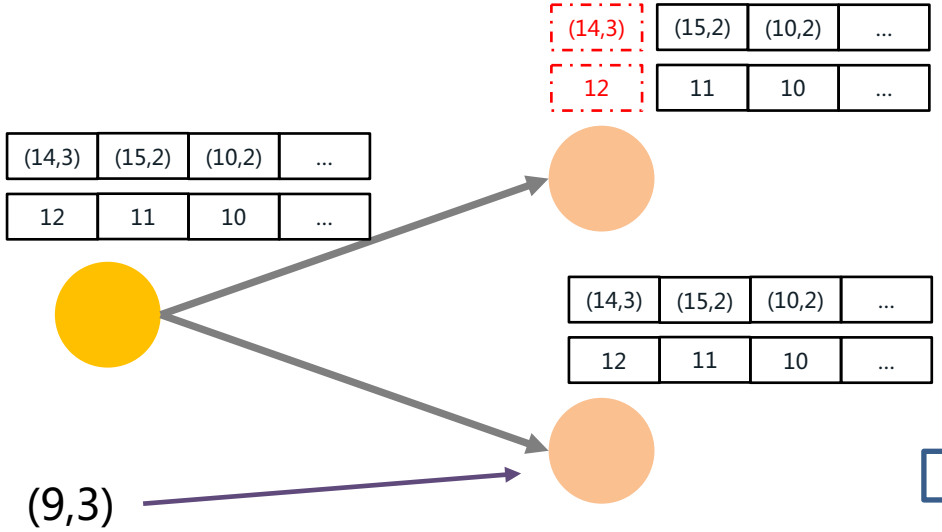
- Read from Leader/Lease holder：
  - ✓ Leader/Lease Holder 能提供一致性读
  - ✓ Follower的delay无法预期

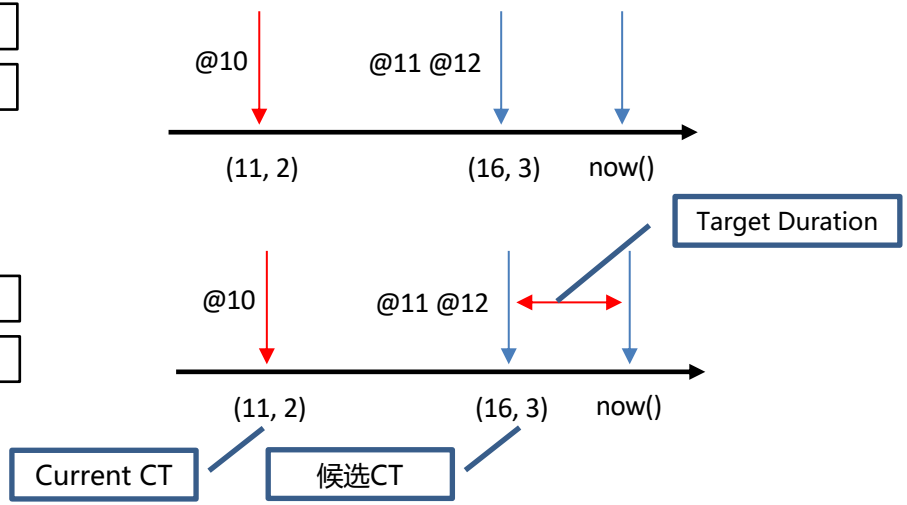
- Read from Follower：
  - ✓ Long Run类型查询
  - ✓ Historical reads
  - ✓ CDC
  - ✓ Immutable tables



一方有难，八方围观！

RFF——在Follower上一致性读

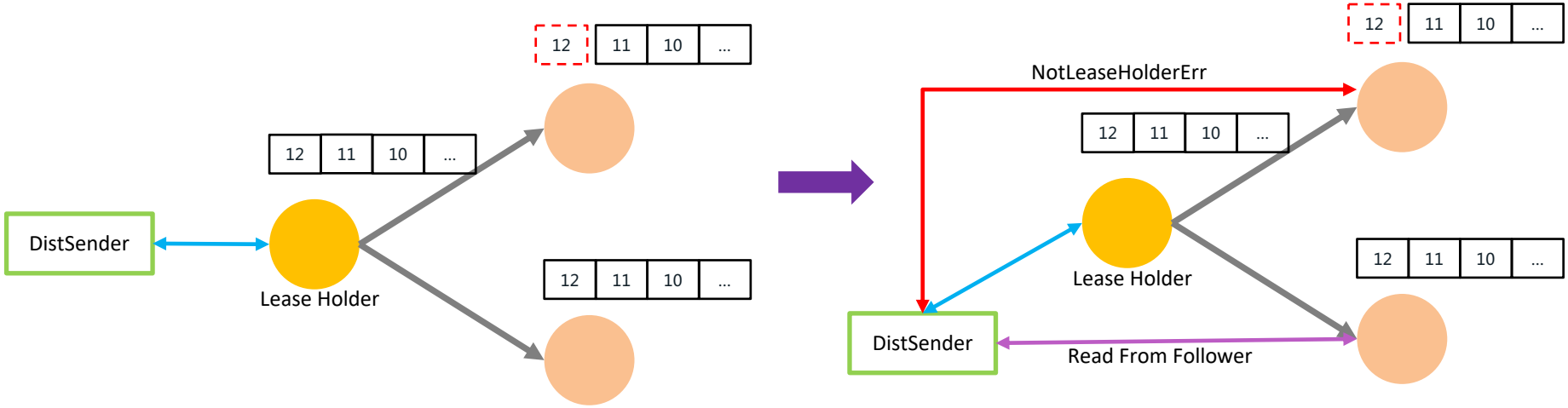




Follower一致性读：

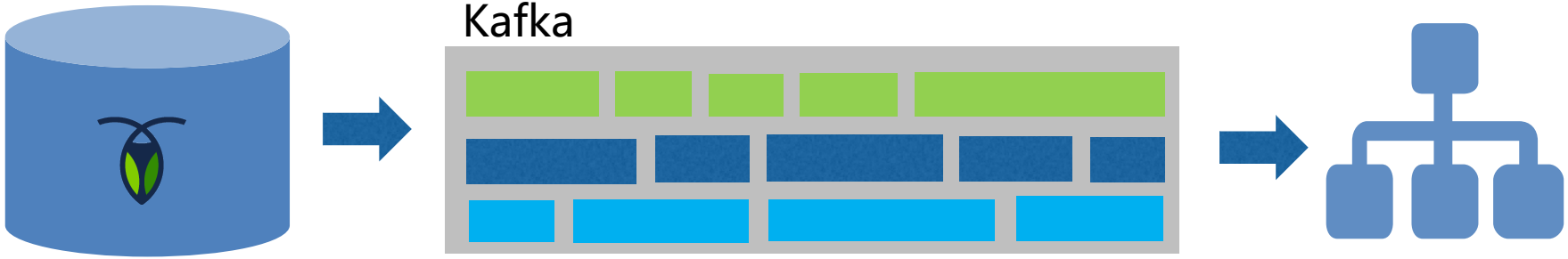
1. Log 的Applied Index 为 X，如果T满足： >= 提交Log X 的事务时间戳，且后续Applied Index > I 的Log的事务时间戳 > T
2. 时间戳<=T的事务可Read From Follower
3. 时间T称为 *Closed Timestamp*

RFF——数据路由



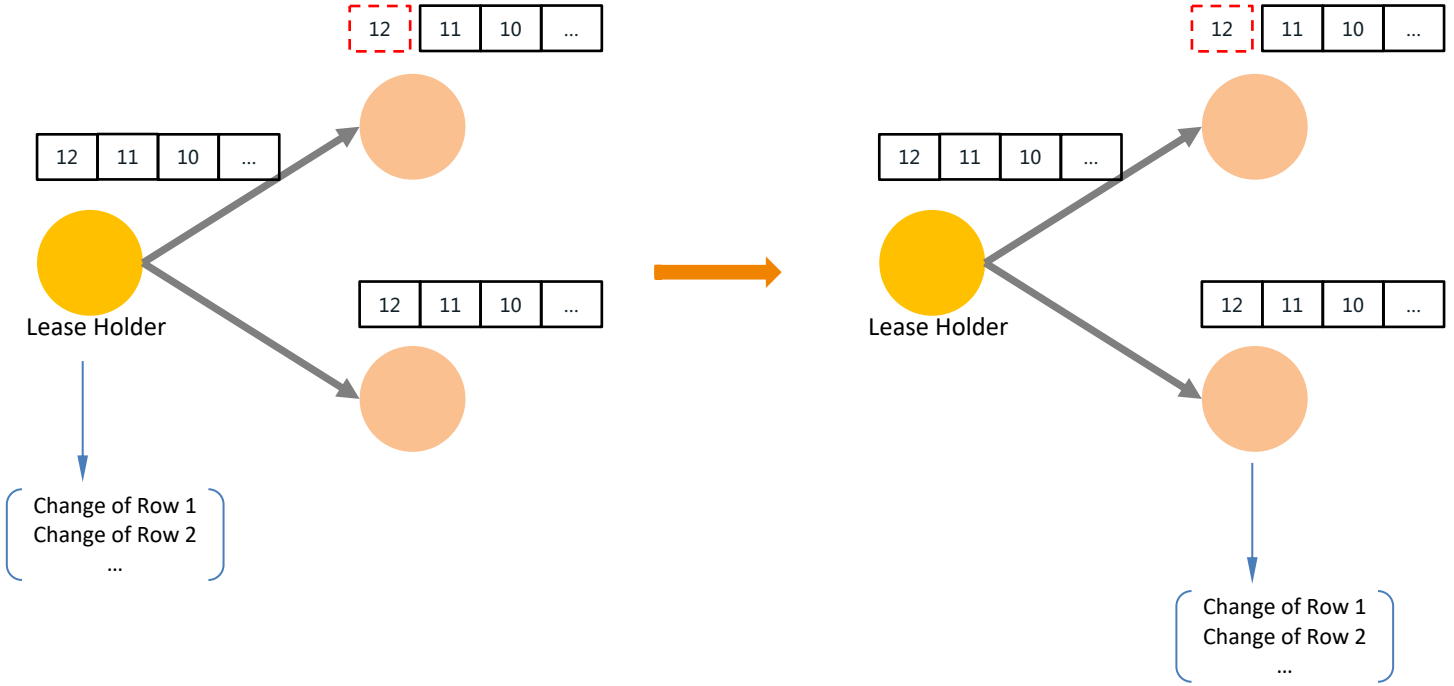
- 优先选择满足条件的最近的Follower
  - ✓ health
  - ✓ latency
  - ✓ locality
- Follower无法满足RFF，则返回NotLeaseHolderErr，请求重新路由到Lease Holder

CDC



- 集群间数据同步，可用于灾备，模拟沙盒环境等。
- 与其他数据生态互通，可用于数据分析，数据挖掘等。

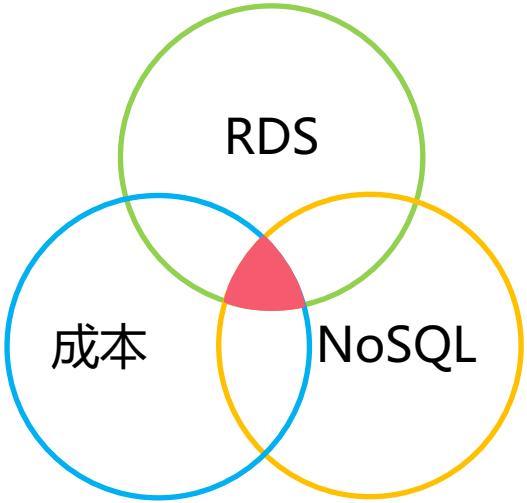
CDC

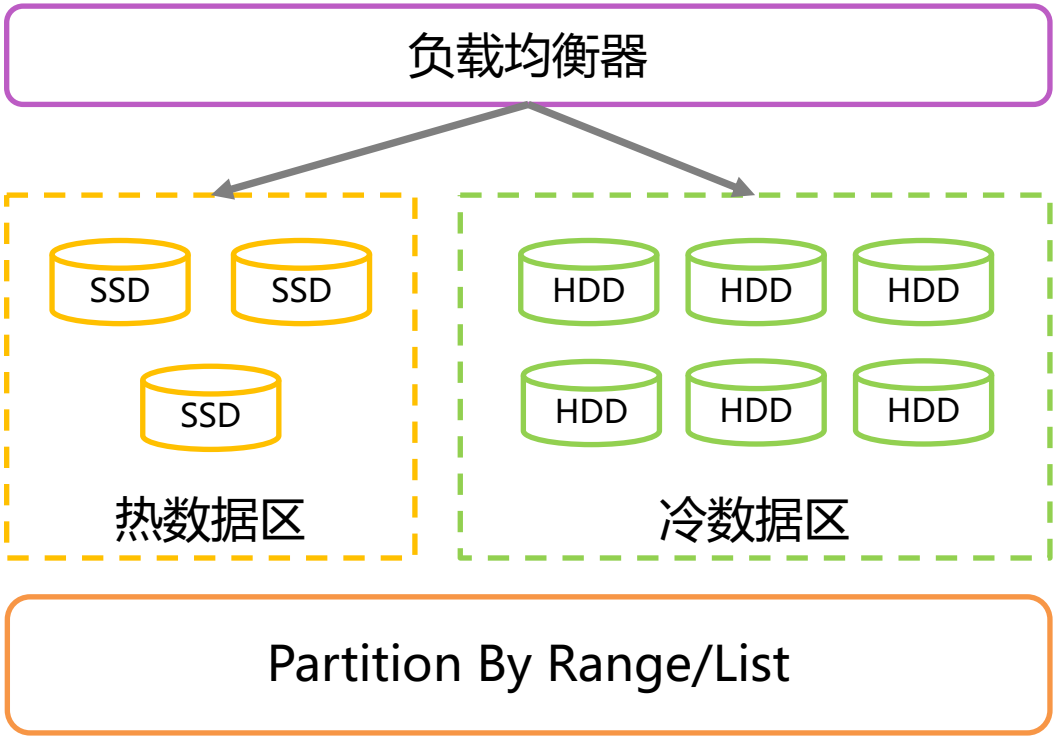

12
11
10
...
12
11
10
...
12
11
10
...
Lease Holder
Change of Row 1
Change of Row 2
...
12
11
10
...
12
11
10
...
12
11
10
...
Lease Holder
Change of Row 1
Change of Row 2
...

PART 03

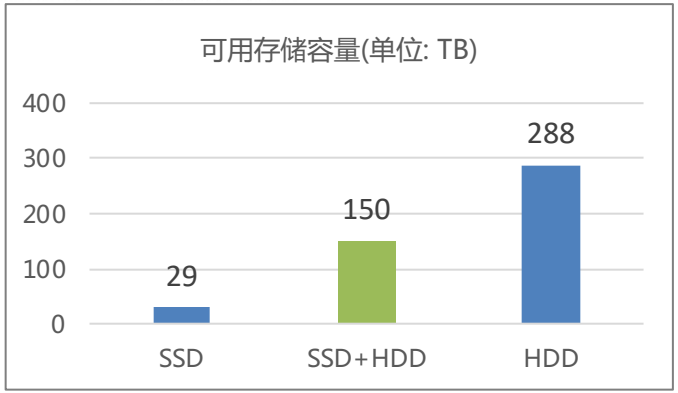
CockroachDB 2.x百度实践

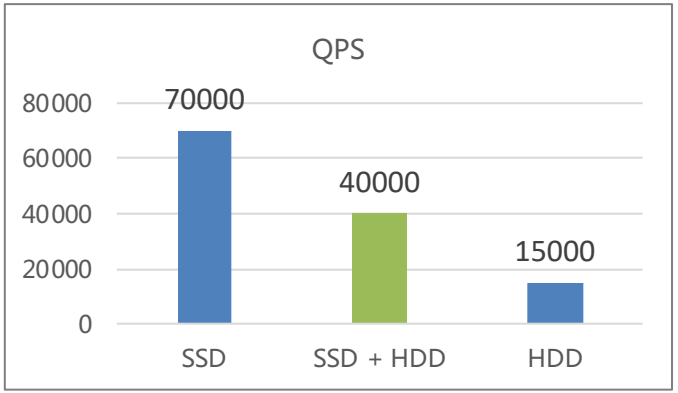
CockroachDB 实践——冷热分离

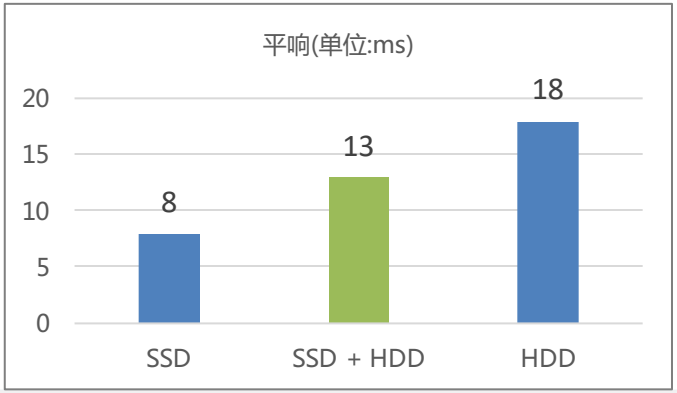




冷热分离


可用存储容量(单位: TB)
400
300
200
100
0
29
150
288
SSD
SSD+HDD
HDD

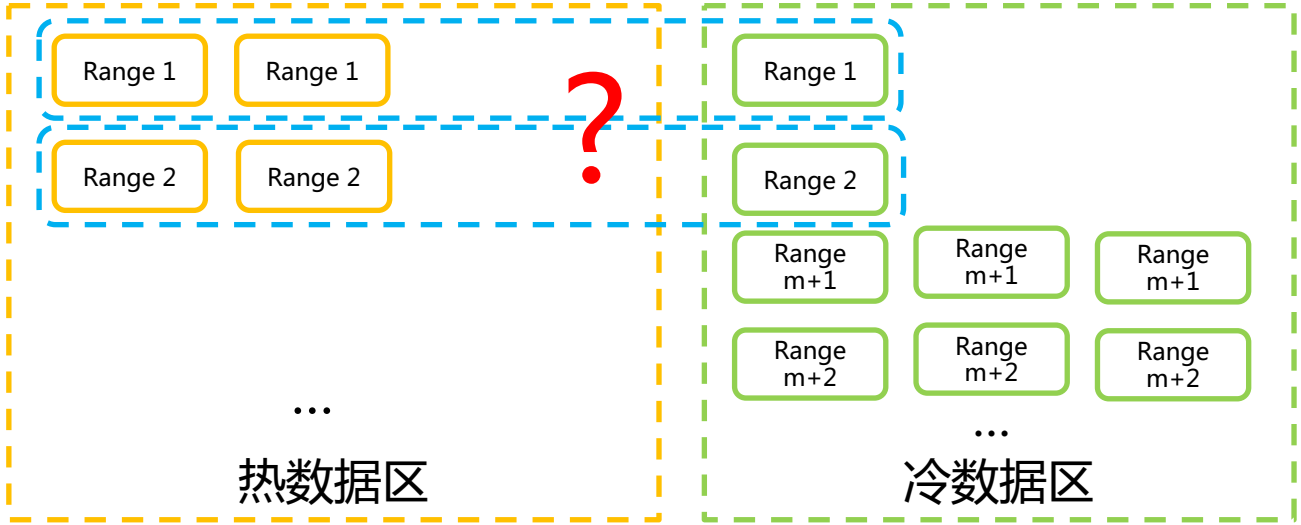

QPS
80000
60000
40000
20000
0
70000
40000
15000
SSD
SSD + HDD
HDD


平响(单位:ms)
20
15
10
5
0
8
13
18
SSD
SSD + HDD
HDD

下一步思考

如何进一步降低热数据长查询、复杂查询对写入的影响

- ✓ Read From Follower 分摊热数据读请求
- ✓ Read From Learner 分摊热数据读请求



PART 04

Roadmap

Roadmap

Schema Change

- Bulk处理，提升性能
- 可视化 – Admin UI “JOBS”
- 可在事务中使用

CBO更多优化

- 有效处理关联子查询
- 引入Plan Cache，加速CBO处理效率
- 优化决策考虑locality就近原则
- Query Optimizer Hints

Core

- Parallel Range Scans
- Load-based splitting
- changefeed推送支持PostgreSQL协议

Security

- 支持Kerberos集成
- Encryption

THANKS

中国社区网站：www.cockroachchina.cn