PingCAP

Scale out your database without pain

Liu Qi

About me

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Codis / TiDB / TiKV

Let’s get started

Thanks to statelessness, we can easily scale **LA P(**without **M)** by adding more machines

Hold on, how about “**M**” ? (MySQL)

What would you do when…

RDBMS is becoming the **performance bottleneck** of your backend service

The **amount** of data stored in RDBMS is overwhelming

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What would you do when…

RDBMS is becoming the performance bottleneck of your backend service

The amount of data stored in RDBMS is overwhelming

Sharding your database or table **manually**, yeah

Or

Sharding by using proxy (vitess, MySQL proxy, kingshard, atlas…)

When things get more complicated…

You want to do some complex queries on a sharding cluster

e.g. simple JOIN or GROUP BY or Subquery

Oh, No...

You need a real distributed database, not sharding.

TiDB: when you need a distributed SQL database

Horizontal scalability (forget about sharding key)

Asynchronous schema changes(feel free to change your schema online)

Consistent distributed transactions (no sharding limits anymore)

Compatible with the MySQL protocol (You know what I mean)

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MySQL Sharding VS TiDB

	MySQL Sharding	TiDB
ACID Transaction Support	✖	✓
Elastic Scaling	✖	✓
Complex Query	✖	✓
Failover	Manual	Auto
MySQL Compatibility	Low	High
Max Capacity (high performance)	< 2TB	200 TB+

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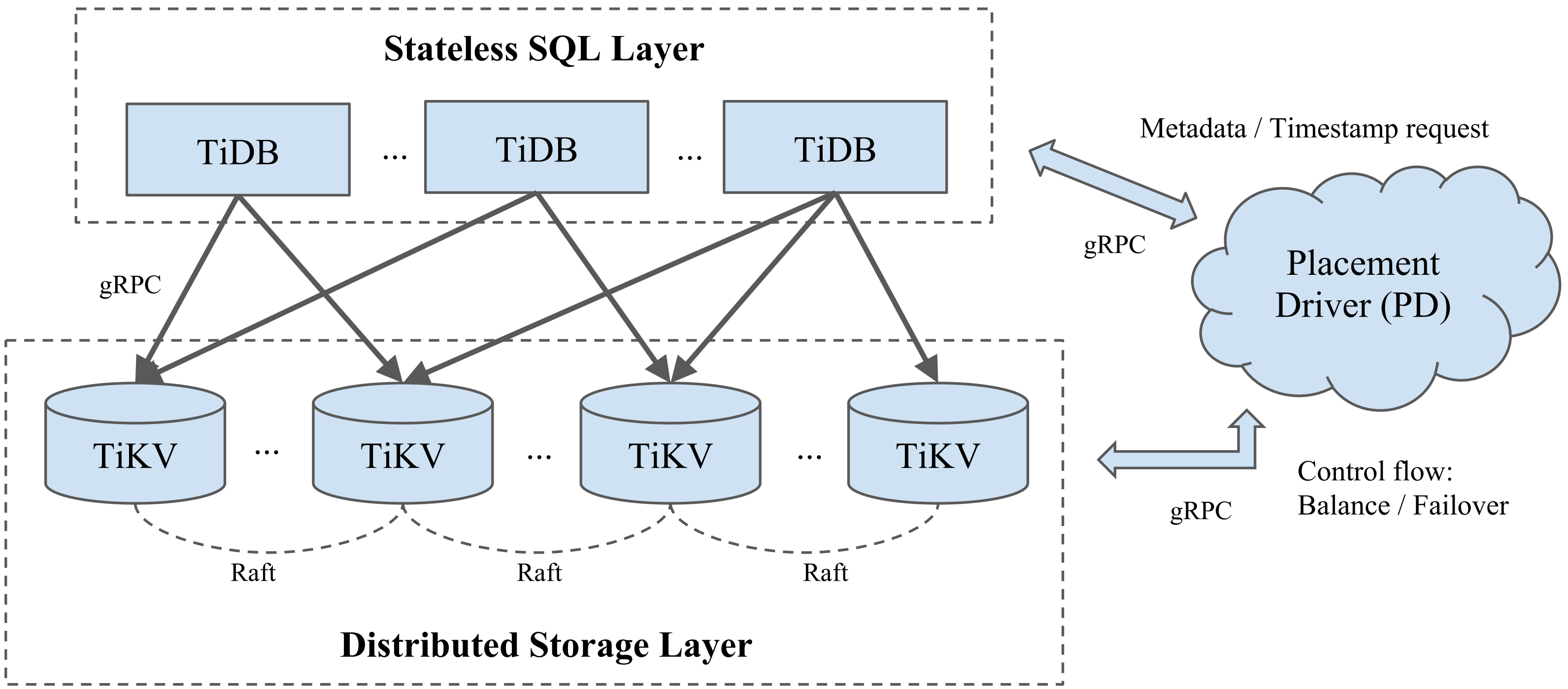
Architecture



Storage stack 1/2

TiKV is the underlying storage layer

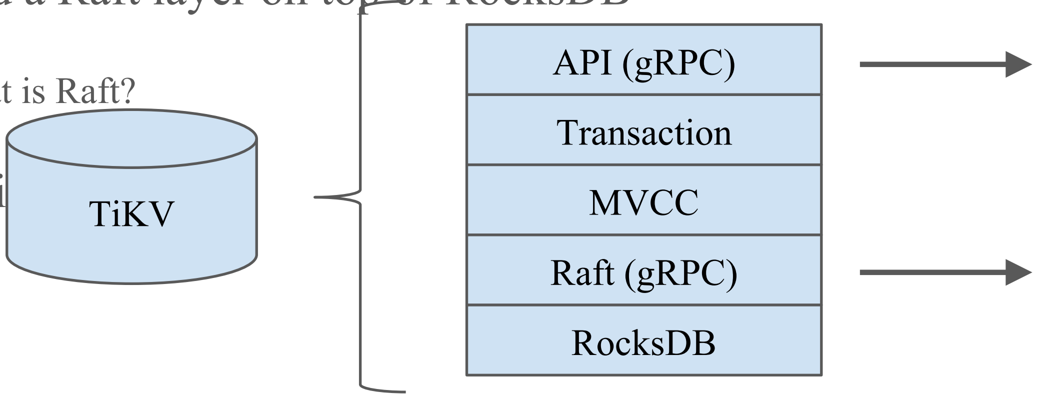
Physically, data is stored in RocksDB

We build a Raft layer on top of RocksDB

What is Raft?

Written i

why



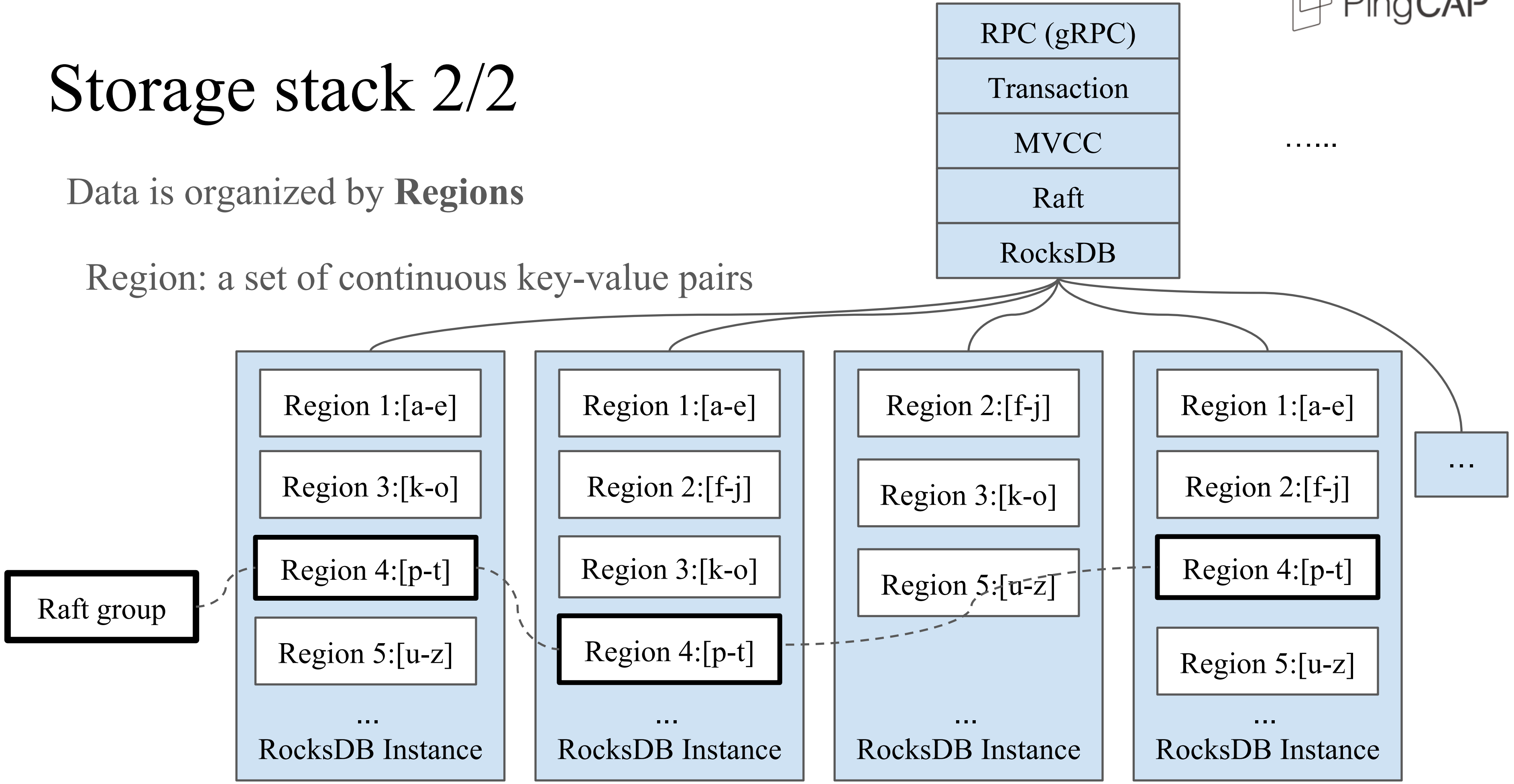
Transactional KV API (https://github.com/pingcap/tidb/blob/master/cmd/benchkv/main.go)

Raw KV API (https://github.com/pingcap/tidb/blob/master/cmd/benchraw/main.go)

Storage stack 2/2

Data is organized by **Regions**

Region: a set of continuous key-value pairs



Region size

Spanner: ~1G

TiDB: 64M ~ 1G   (configurable)

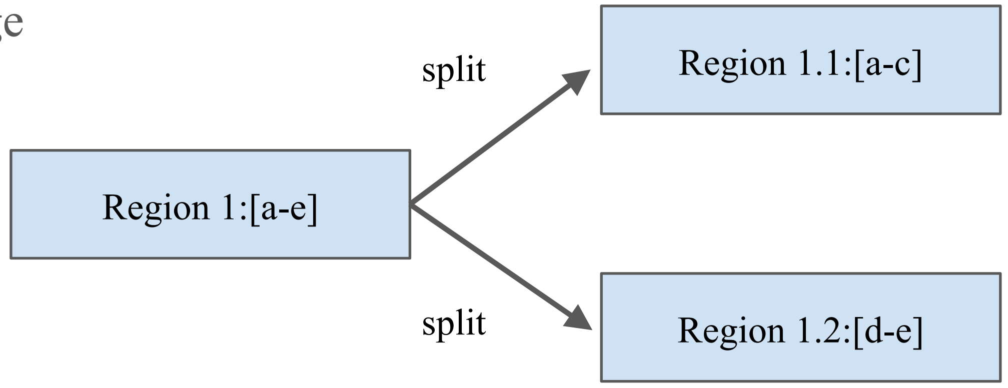
Depending on the network quality

Dynamic Multi-Raft

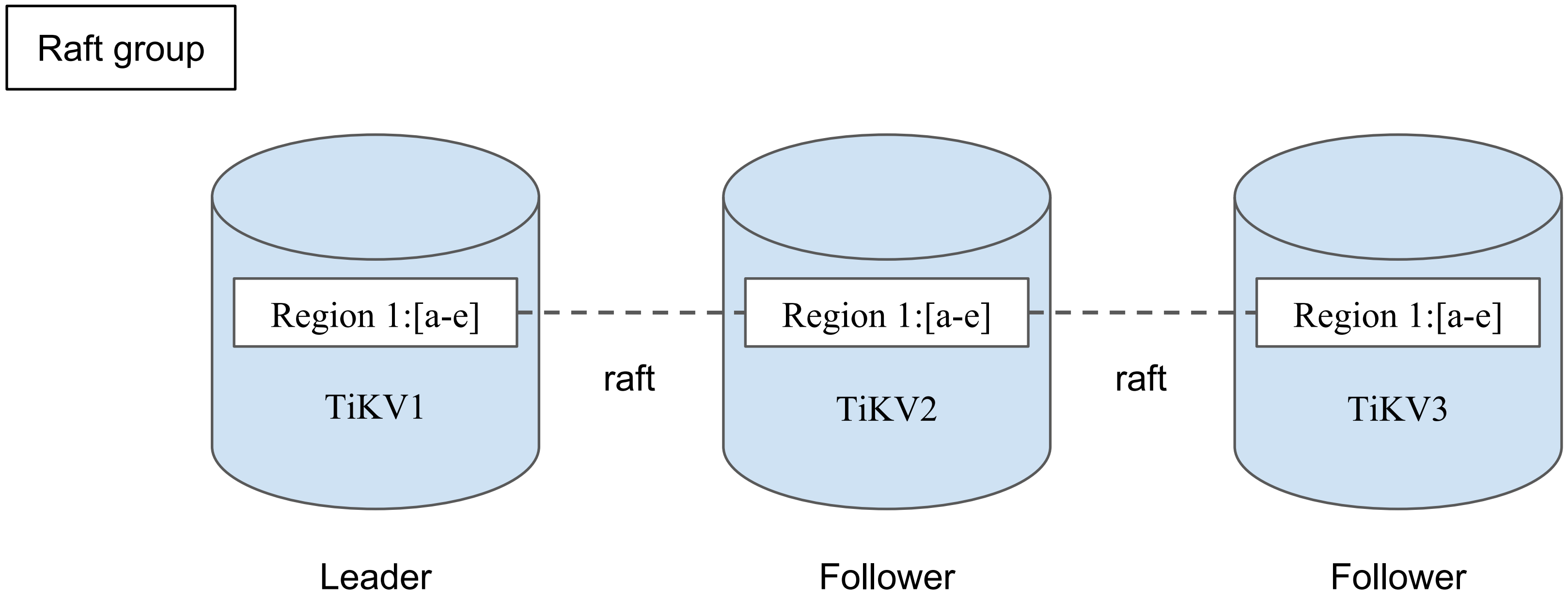
What’s Dynamic Multi-Raft?

Dynamic split / merge

Safe split / merge



Safe Split: 1/4



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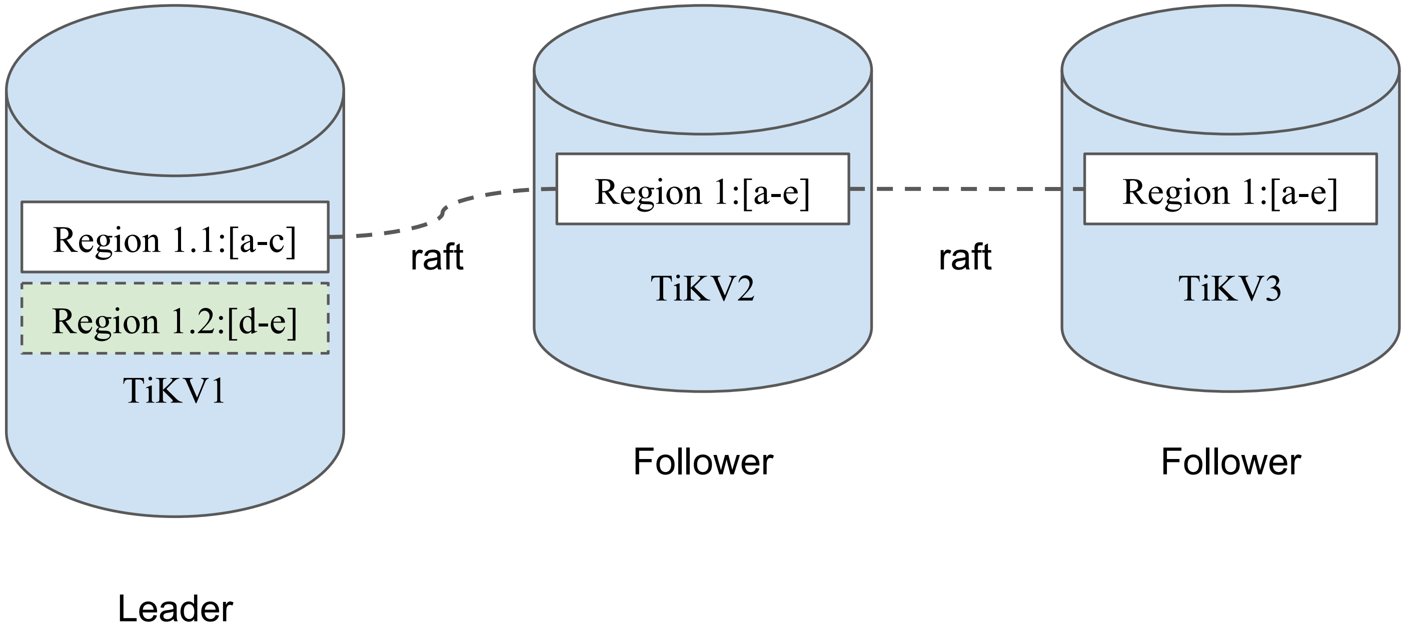
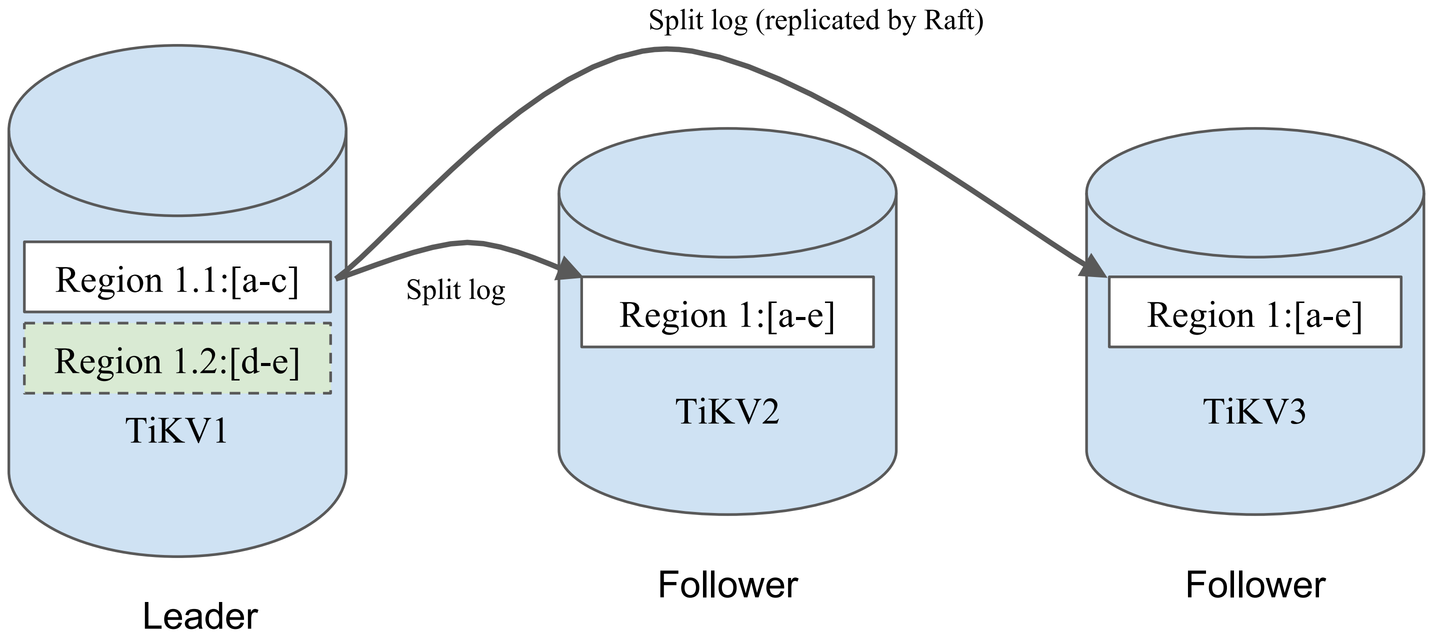
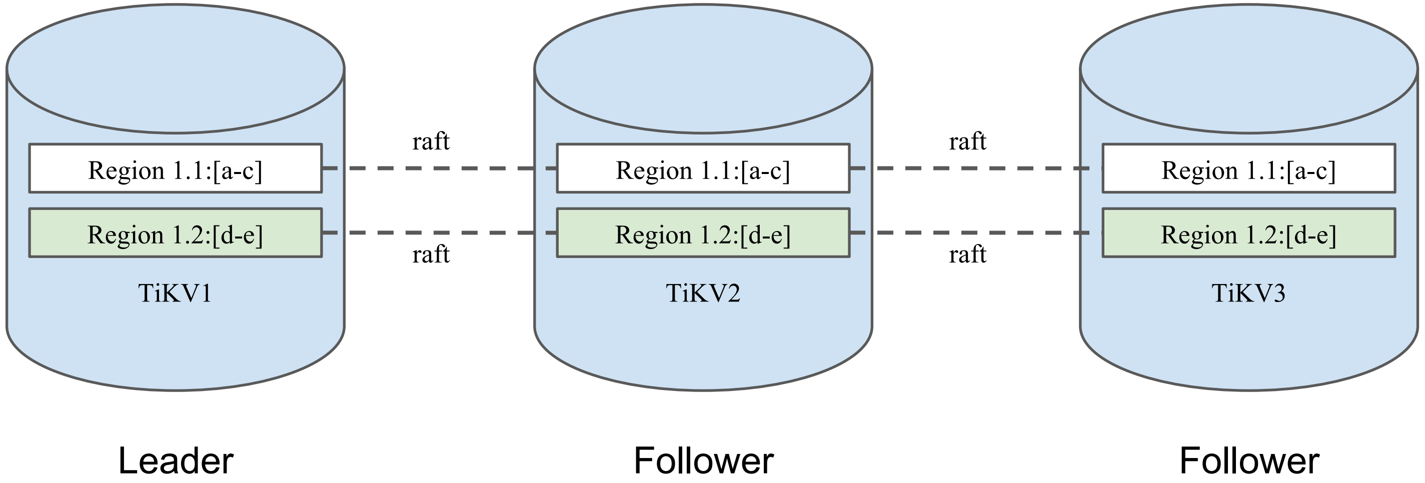
Safe Split: 2/4



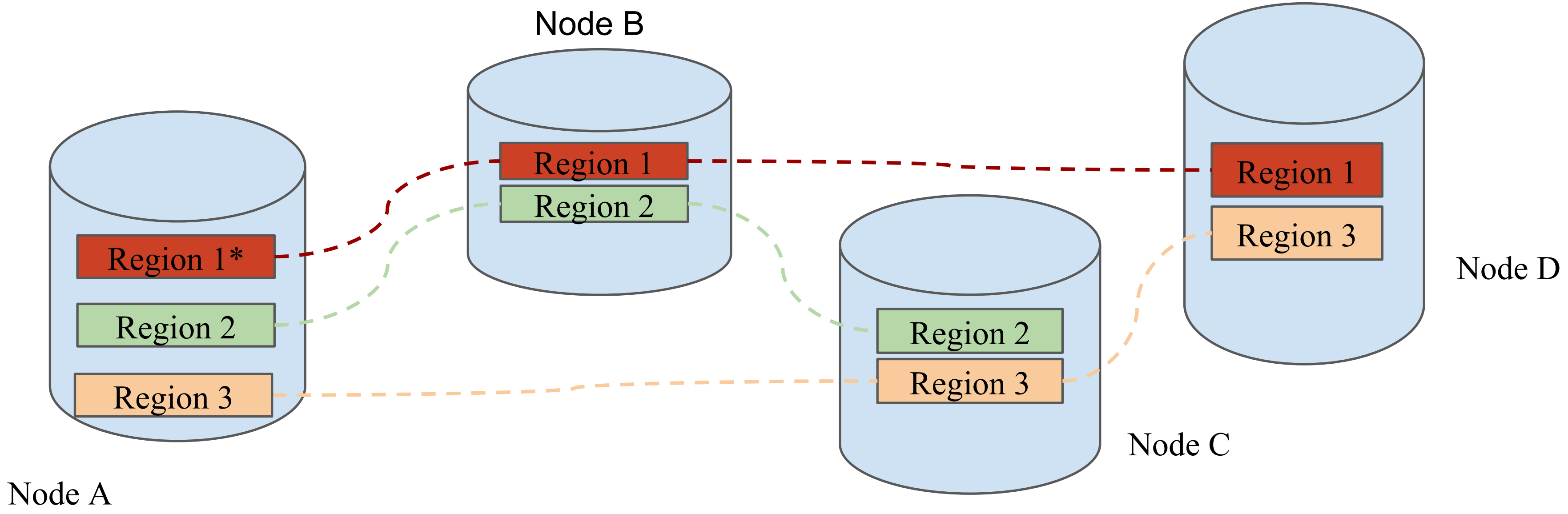
Safe Split: 3/4



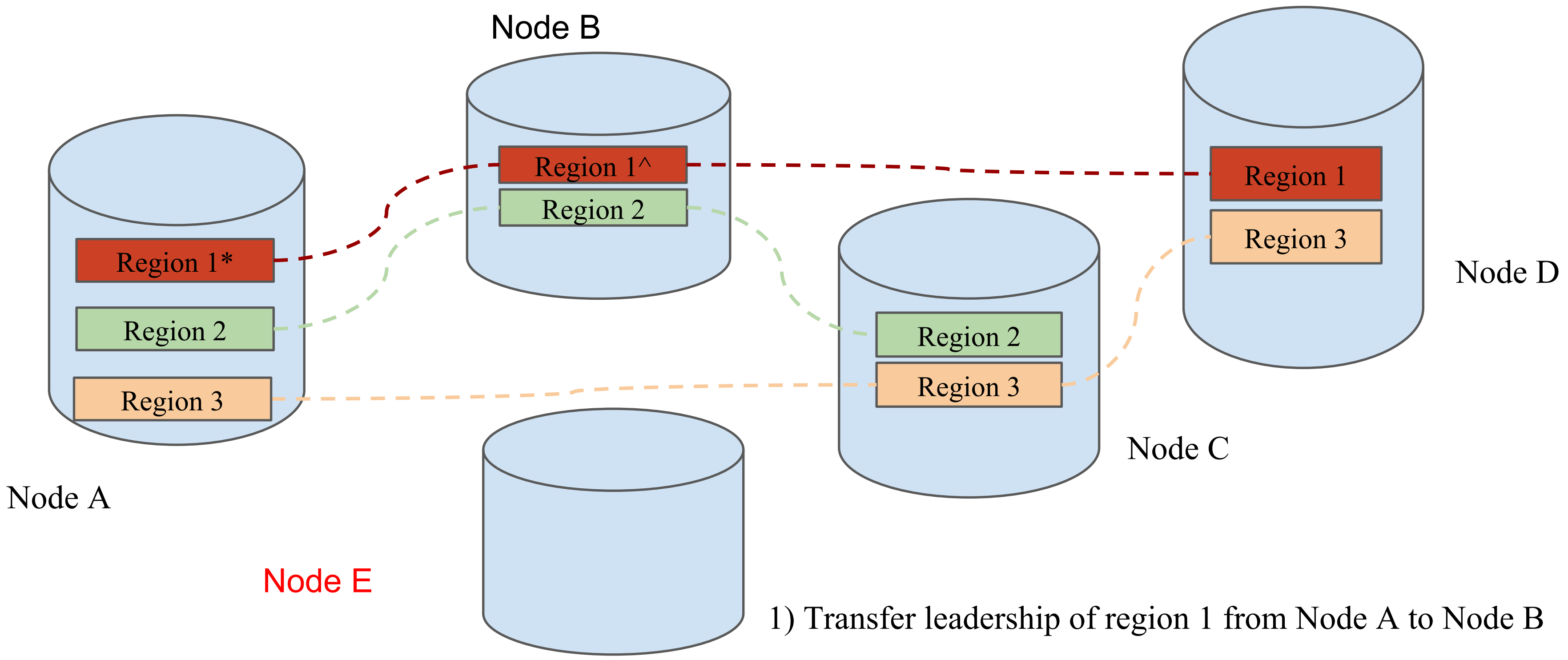
Safe Split: 4/4



Scale-out (initial state)

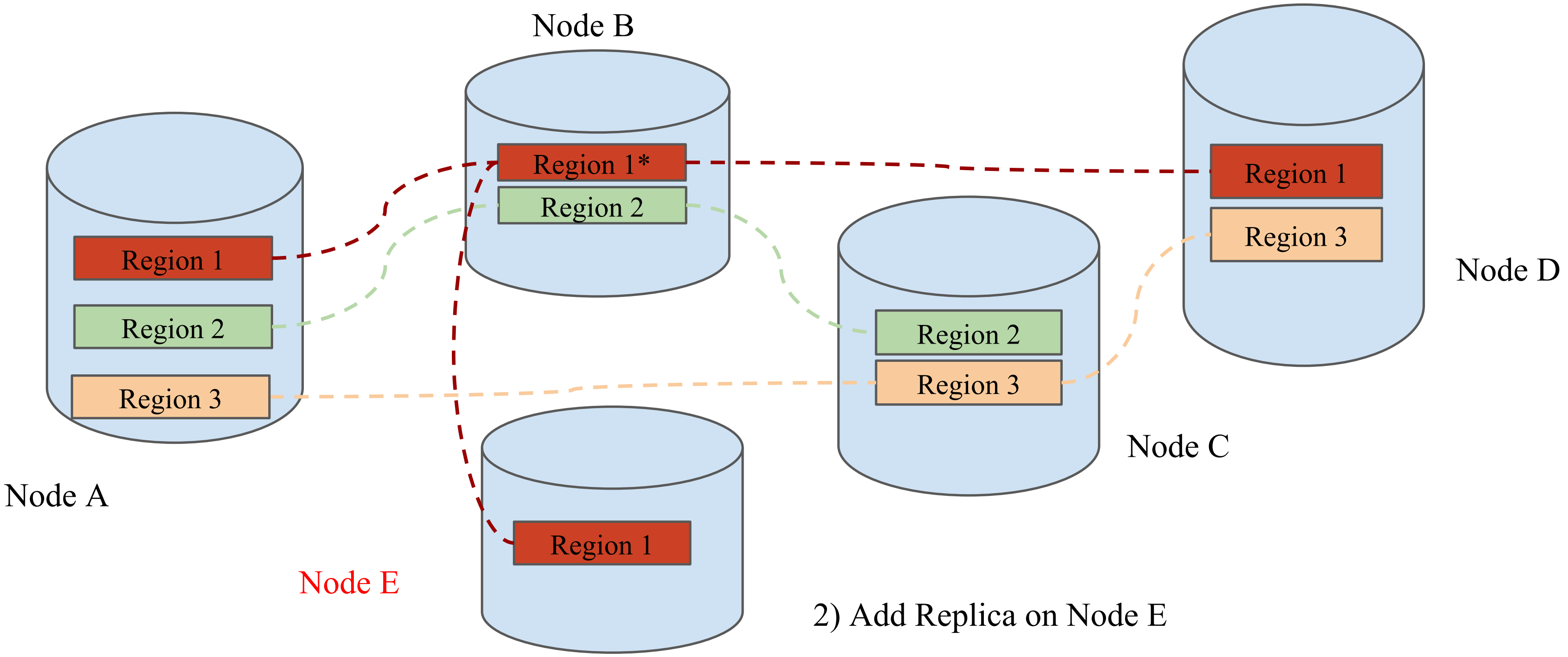


Scale-out (add new node)



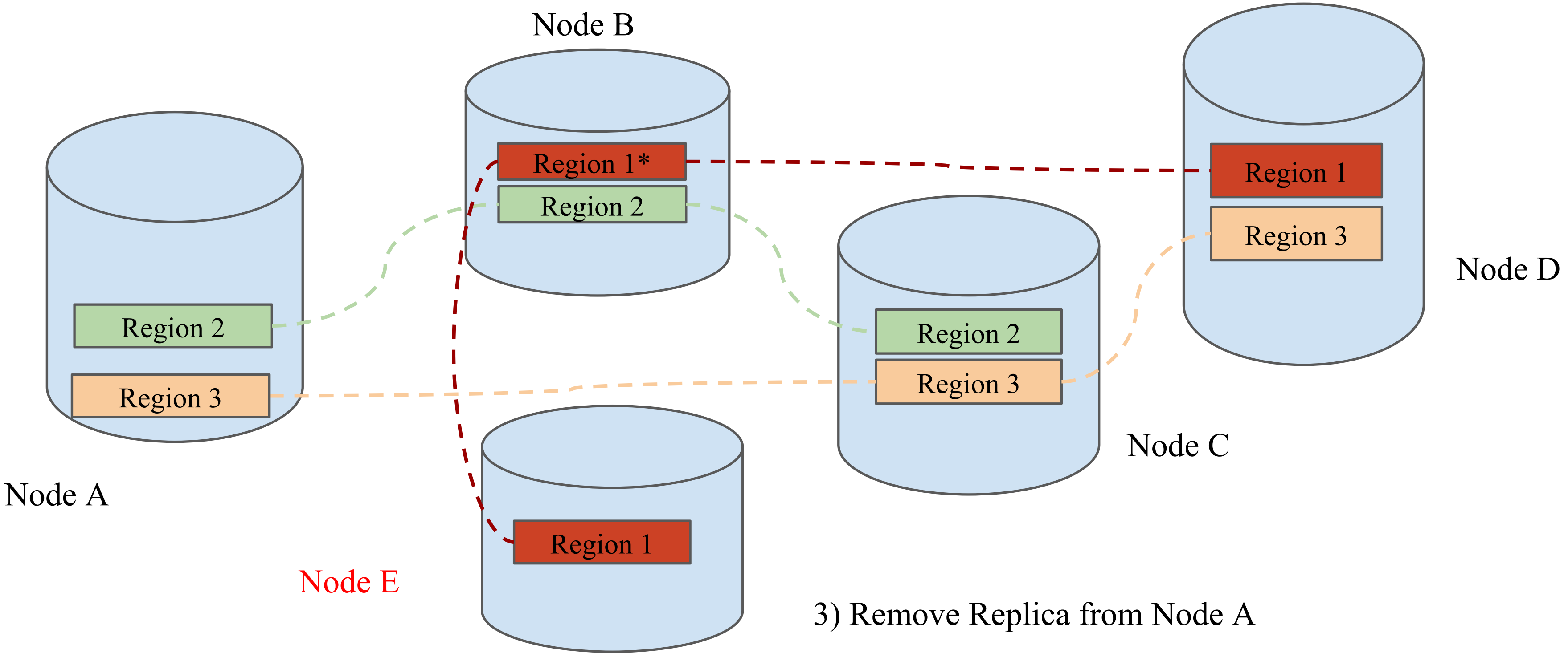
1) Transfer leadership of region 1 from Node A to Node B

Scale-out (balancing)



2) Add Replica on Node E

Scale-out (balancing)



3) Remove Replica from Node A

Placement Driver

The concept comes from Spanner

Provide the God's view of the entire cluster

Store the metadata

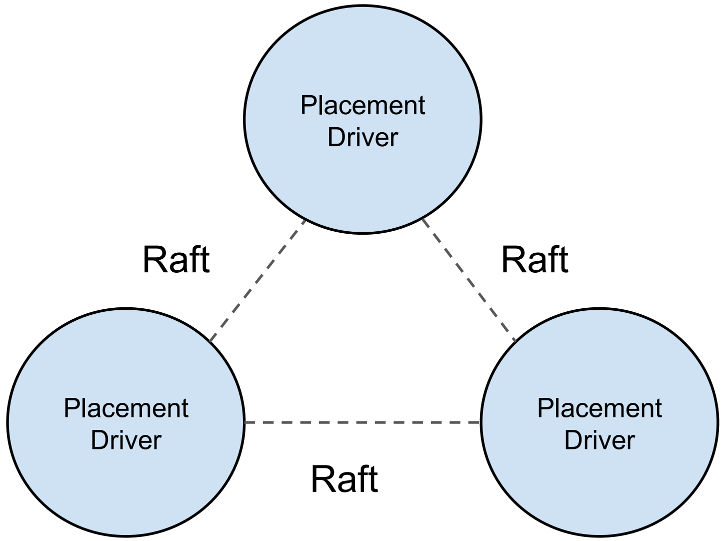
- Clients have cache of placement information.

Maintain the replication constraint

- 3 replicas, by default

Data **movement** for balancing the workload

It's a cluster too, of course.



ACID Transaction

- The transaction API is in TiKV
- Based on Google Percolator
- ‘Almost’ decentralized 2-phase commit
  - Timestamp Allocator (PD)
  - ~8M timestamps allocations per second
- Optimistic transaction model
- Default isolation level: Repeatable Read
- External consistency: Snapshot Isolation + Lock

Distributed SQL

Full-featured SQL layer

Predicate pushdown

Distributed join

Distributed cost-based optimizer (Distributed CBO)

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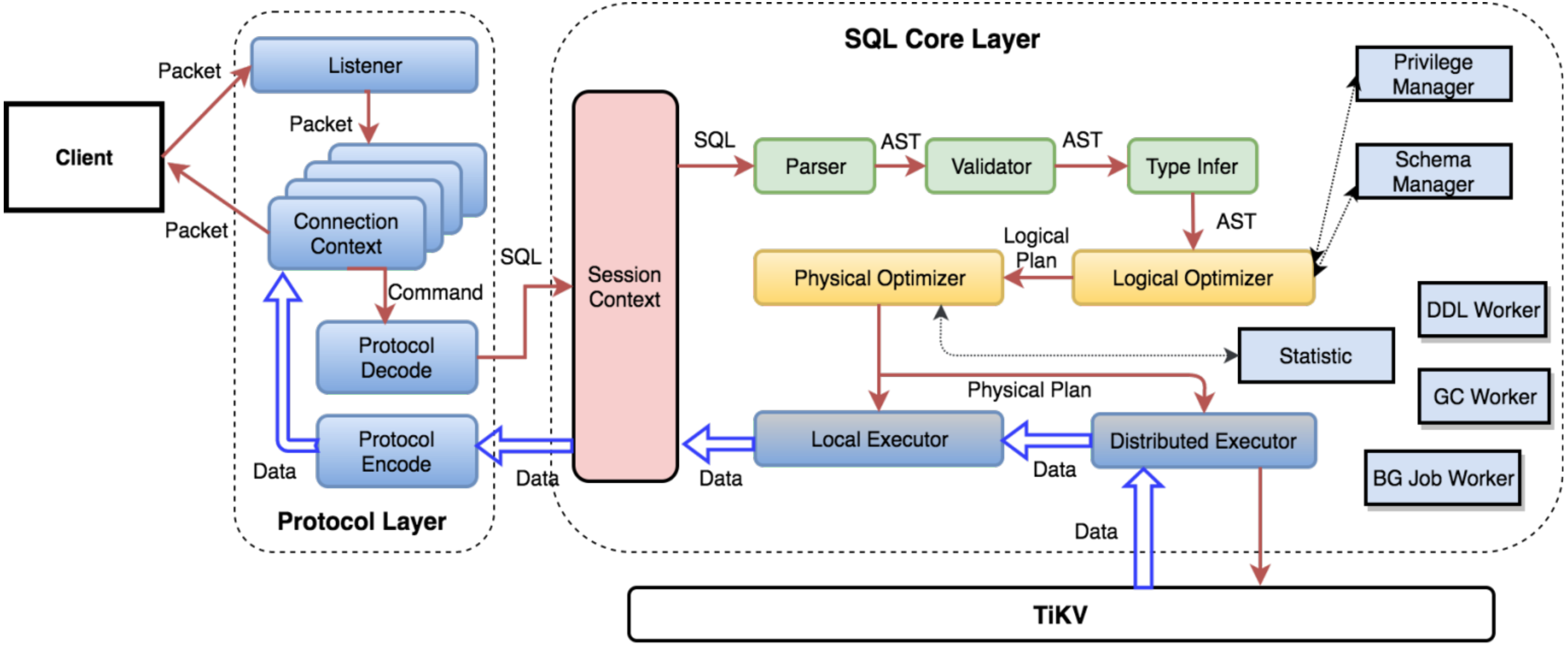
TiDB SQL Layer overview

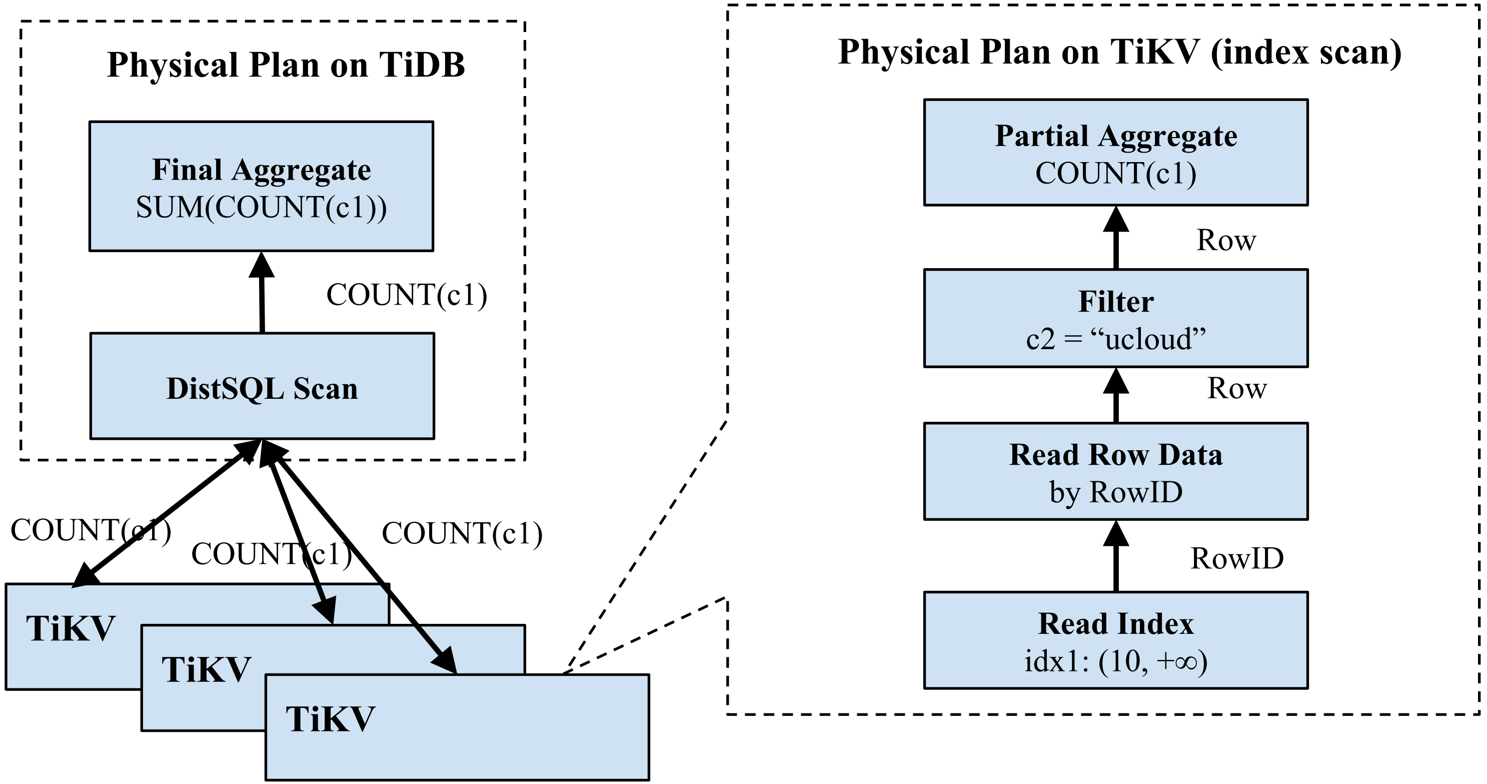


What happens behind a query

```
CREATE TABLE t (c1 INT, c2 TEXT, KEY idx_c1(c1));

SELECT COUNT(c1) FROM t WHERE c1 > 10 AND c2 = ‘foo’;
```

Query Plan


Physical Plan on TiDB
Final Aggregate
SUM(COUNT(c1))
COUNT(c1)
DistSQL Scan
COUNT(c1)
COUNT(c1)
COUNT(c1)
TiKV
TiKV
TiKV
Physical Plan on TiKV (index scan)
Partial Aggregate
COUNT(c1)
Row
Filter
c2 = "ucloud"
Row
Read Row Data
by RowID
RowID
Read Index
idx1: (10, +∞)

Supported Distributed Join Type

Hash Join

Sort merge Join

Index-lookup Join

No silver bullet (anti-patterns for TiDB SQL)

Join between large tables without index or any hints

Get distinct values from large tables without index

Sort without index

Result set is too large (forget LIMIT N?)

What makes TiDB slow?

Hot and **small** table accessing

- TiDB can’t redistribute your workload

If you always **append** to 1 table, the hotspot will always exist in the last region of this table.

- TiDB isn’t a time series database

Auto-increment ID / Timestamp index

Best practices

Don’t use distributed database if you can handle your data with a **single** MySQL instance

Best practices

Use ansible to maintain your cluster (for private deployment)

Don’t use network block devices, please use **ssd**

Careful about the Auto Increment ID (always append to a table)

Best practices

Read the documents first

Need help?

- File issues
- Google Group
- Email: info@pingcap.com

Tools matter

Syncer

TiDB-Binlog

Mydumper/MyLoader(loader)

https://github.com/pingcap/tidb-tools

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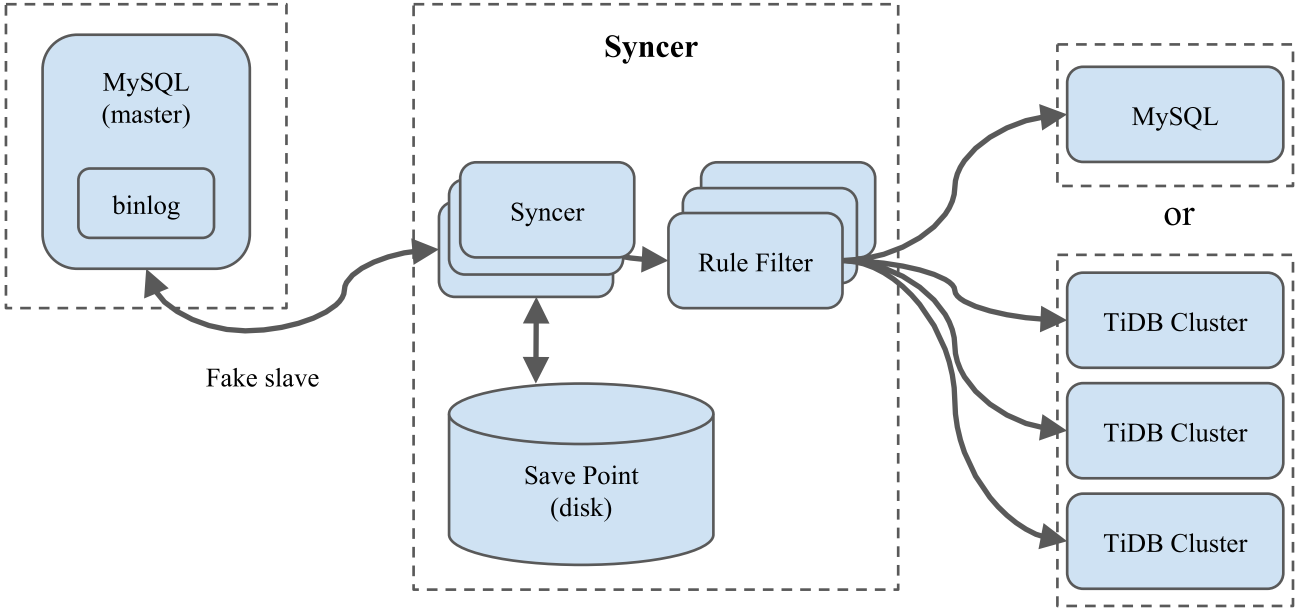
Syncer

Synchronize data from MySQL in real-time

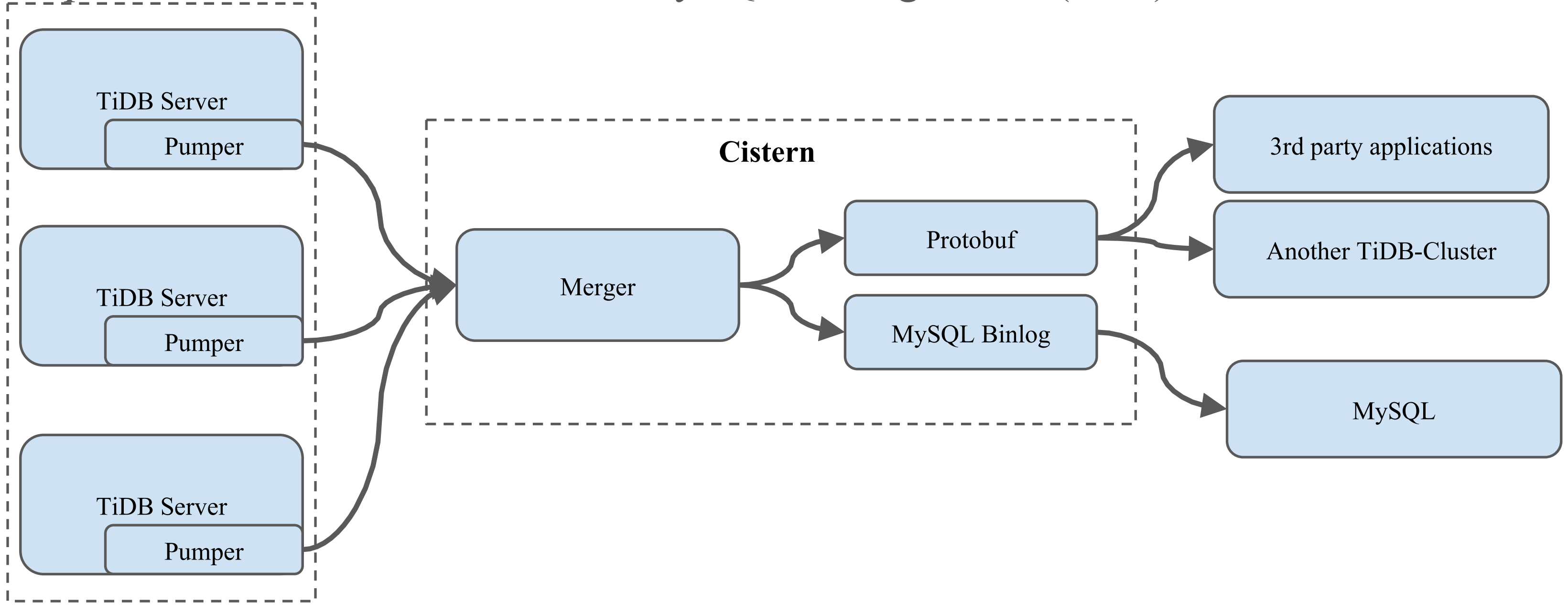
Hook up as a MySQL replica



TiDB-Binlog

Subscribe the incremental data from TiDB

Output Protobuf formatted data or MySQL Binlog format(WIP)



Roadmap

TiSpark: Integrate TiKV with SparkSQL （2017.07）

Better optimizer (Statistic && CBO)

Json type and **document store** for TiDB （2017.09）

MySQL 5.7.12+ X-Plugin

Integrate with Kubernetes （2017.07）

Integrate with UCloud and more, yay~

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Thank you

https://github.com/pingcap/tidb

https://github.com/pingcap/tikv

Any questions?