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Go in TiDB

Yao Wei | PingCAP

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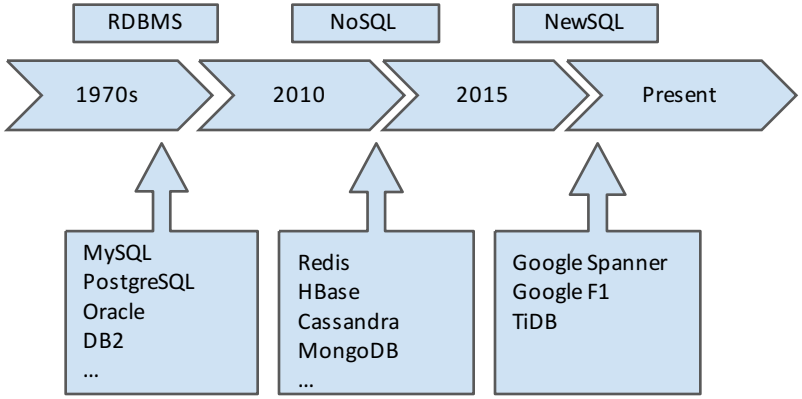
About me

- Yao Wei (姚维)
- TiDB Kernel Expert, General Manager of South Region, China
- 360 Infra team / Alibaba-UC / PingCAP
- Atlas/MySQL-Sniffer
- Infrastructure software engineer

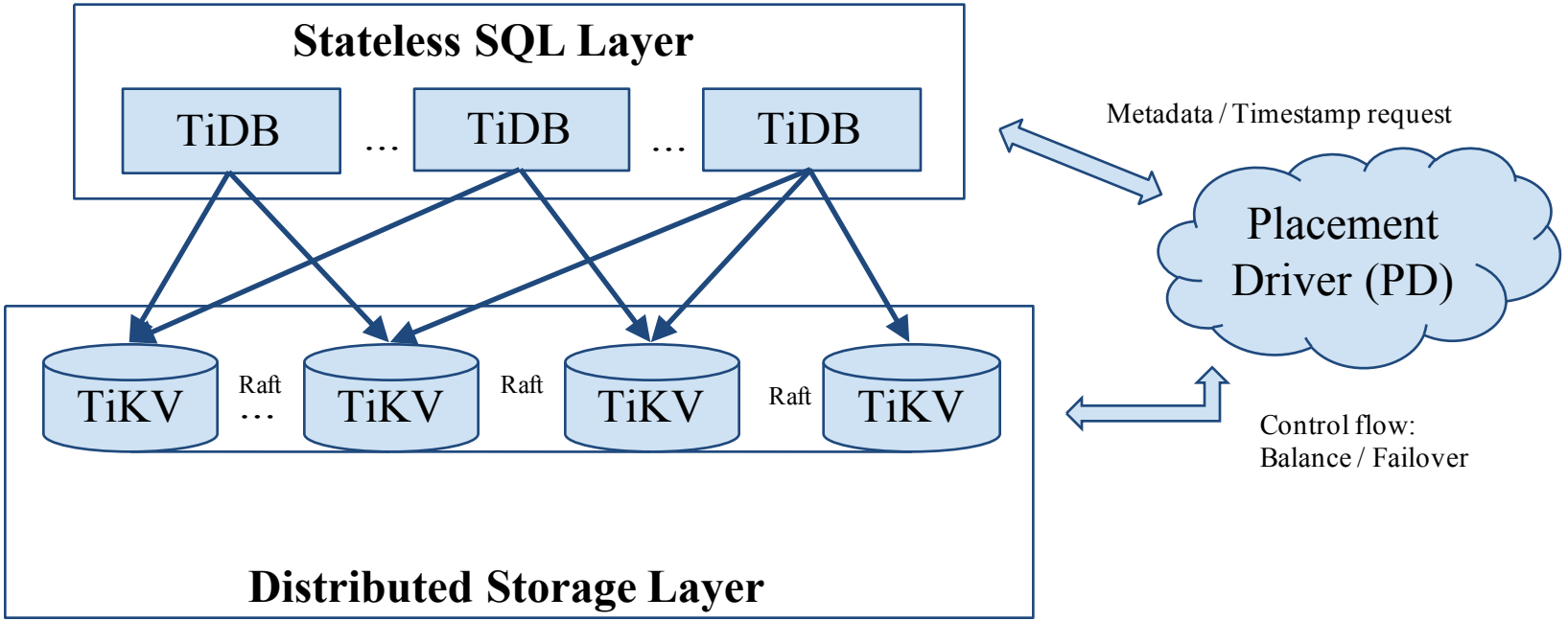
Why a new database?

Brief History

- Standalone RDBMS
- NoSQL
- Middleware & Proxy
- NewSQL

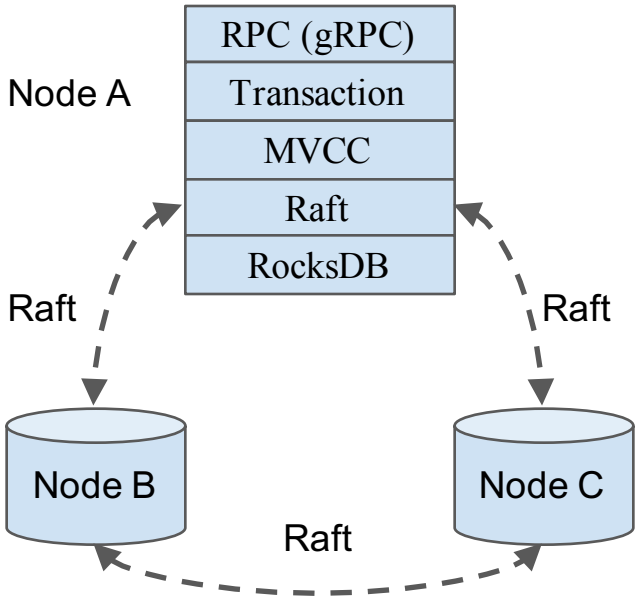


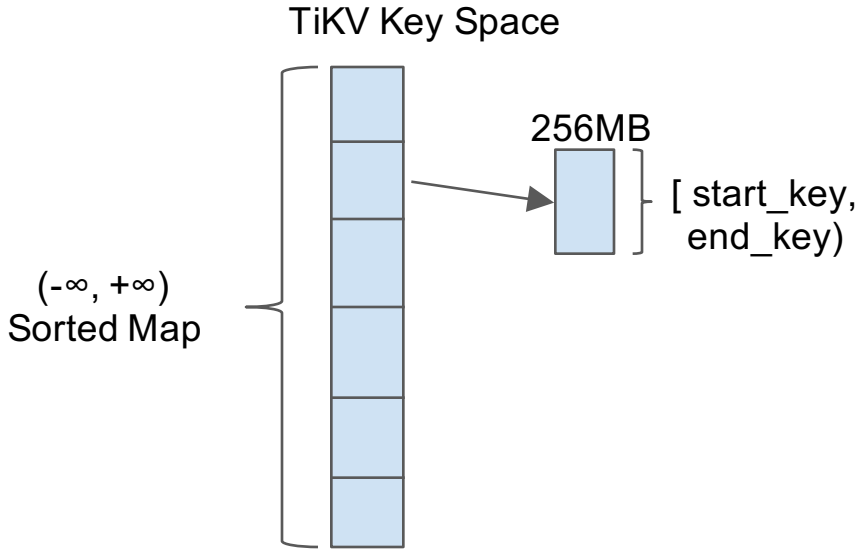
Architecture



TiKV - Overview

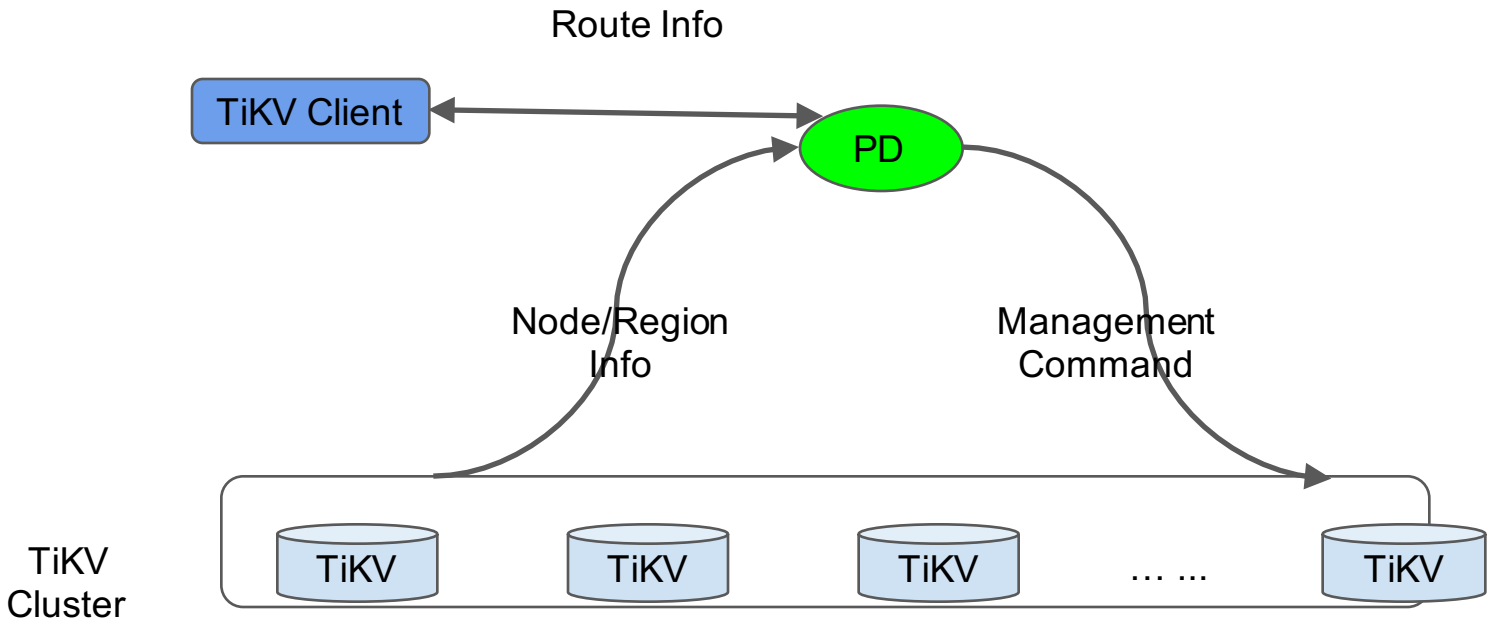
- **Region: a set of continuous key-value pairs**
- **Data is organized/stored/replicated by Regions**
- **Highly layered**





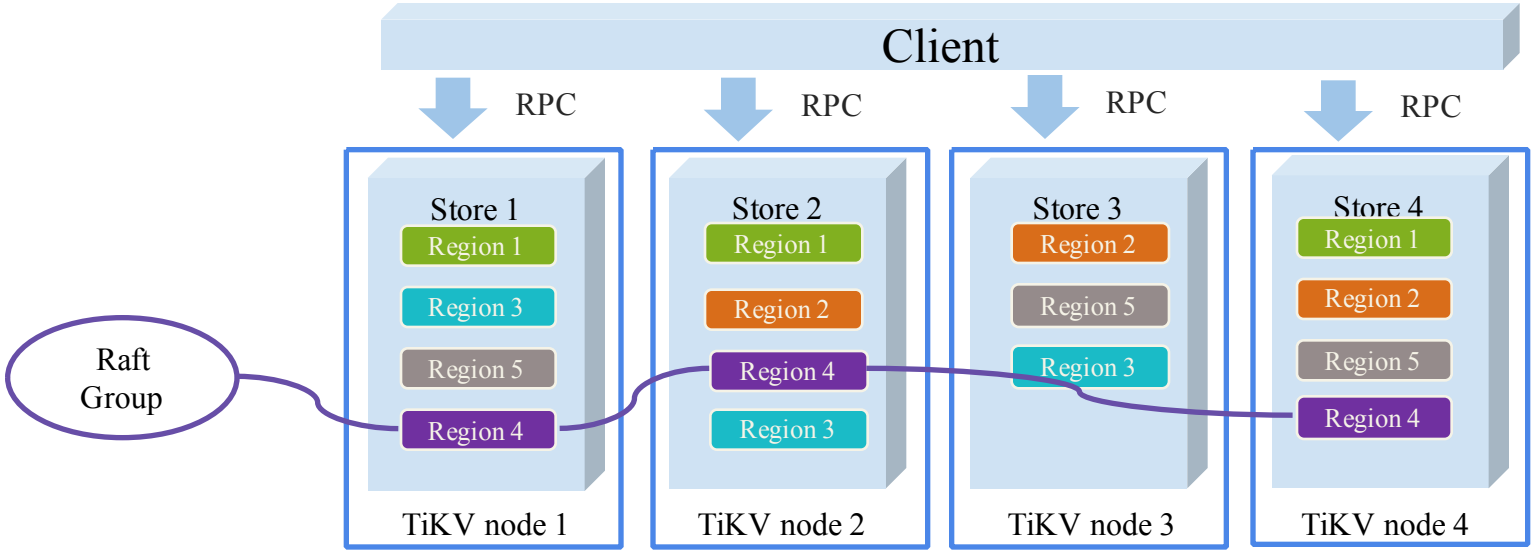
PD - Overview

- Meta data management
- Load balance management

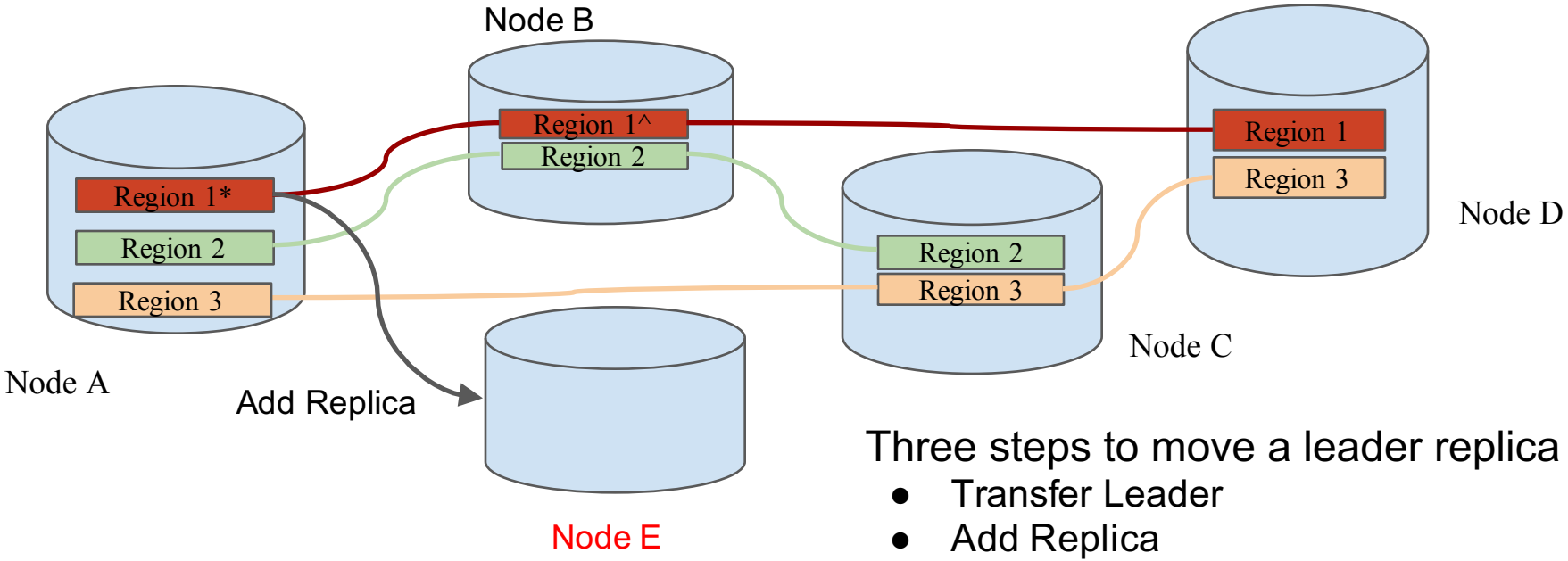


TiKV - Multi-Raft

Multiple raft groups in the cluster, one group for each region.



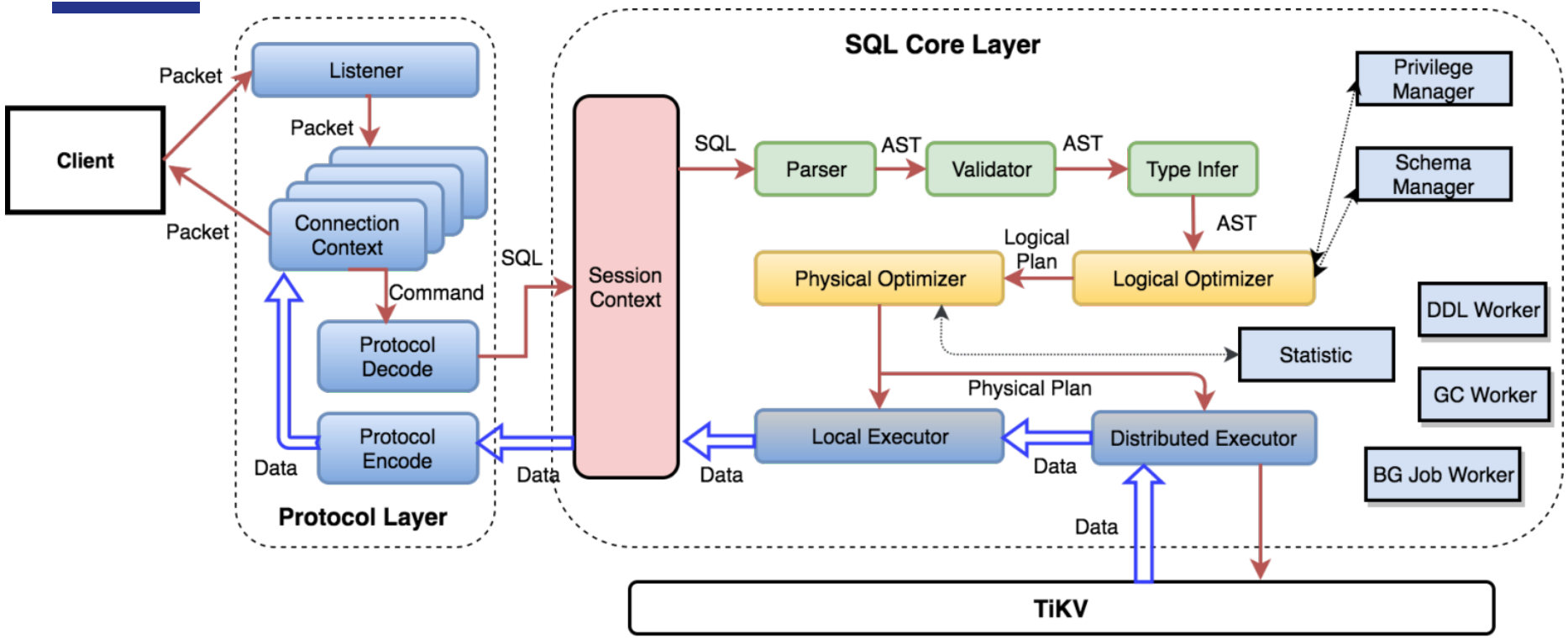
TiKV - Horizontal Scale



Three steps to move a leader replica

- Transfer Leader
- Add Replica
- Remove Replica

SQL Layer


Client
Packet
Packet
Packet
Listener
Connection Context
Command
Protocol Decode
Protocol Encode
Data
Protocol Layer
SQL
Session Context
Data
SQL Core Layer
SQL
Parser
AST
Validator
AST
Type Infer
AST
Logical Plan
Physical Optimizer
Logical Optimizer
Privilege Manager
Schema Manager
Statistic
DDL Worker
GC Worker
BG Job Worker
Physical Plan
Local Executor
Distributed Executor
Data
Data
Data
TiKV

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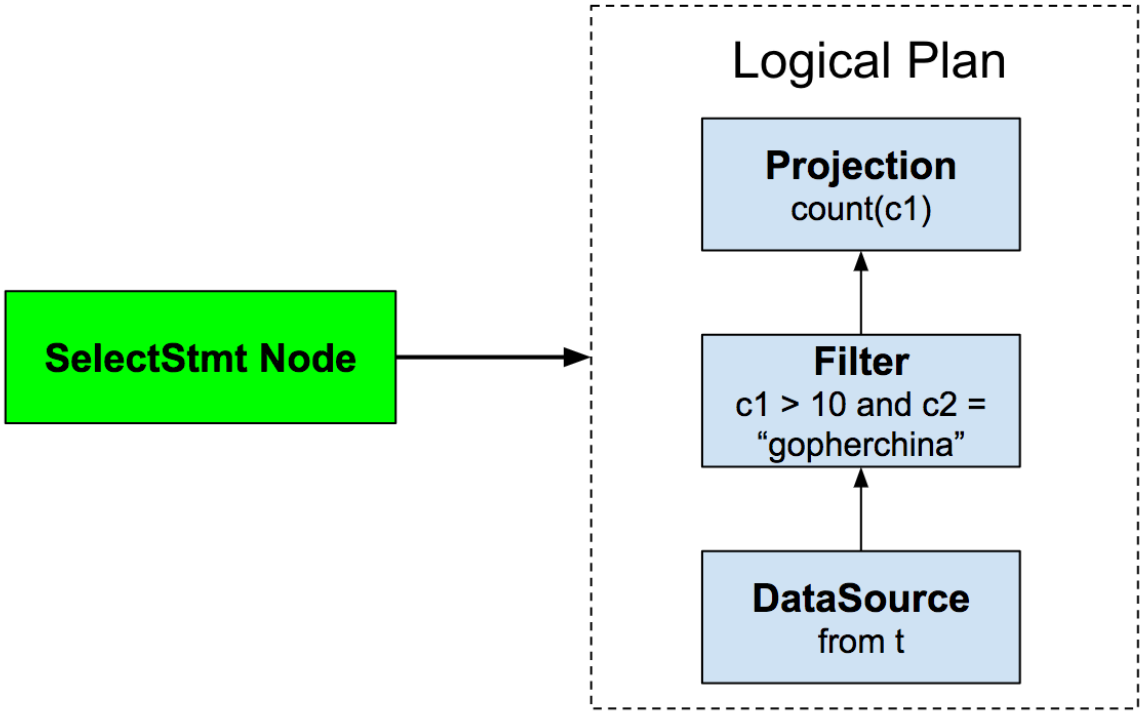
Example - SQL

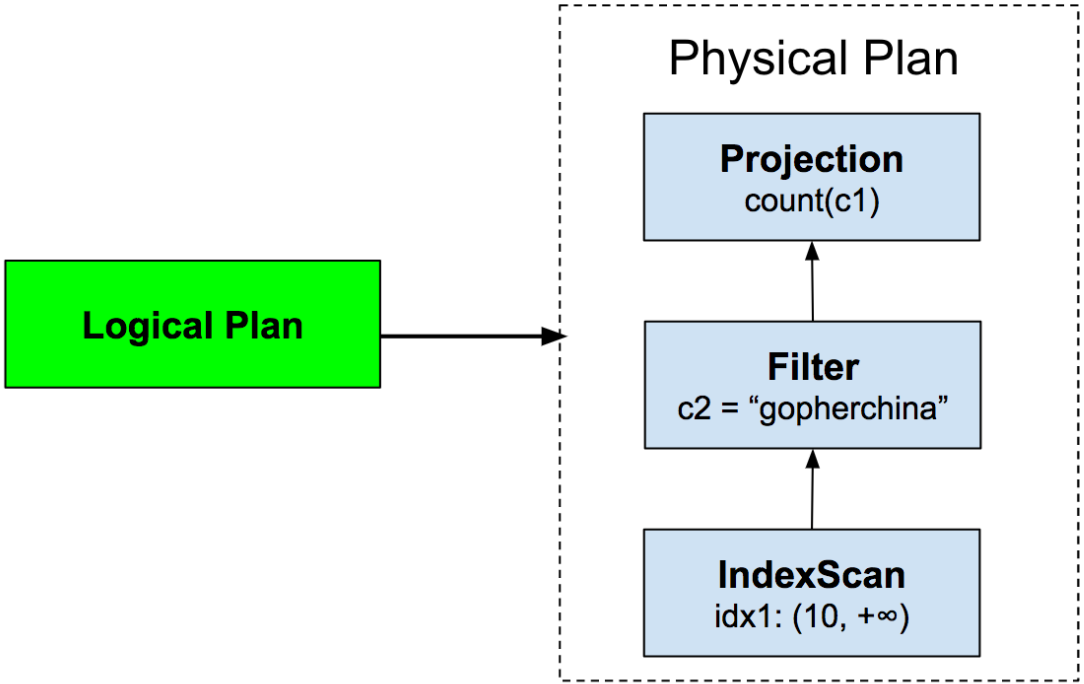
```
CREATE TABLE t (c1 INT, c2 VARCHAR(32), INDEX idx1 (c1));

SELECT COUNT(c1) FROM t WHERE c1 > 10 AND c2 =
“gopherchina”;
```

Example - Logical Plan



Example - Physical Plan



Challenges of distributed ACID database?

- Distributed Database is very complex
- Lots of RPC work
- Keep high performance
- Tons of data
- Huge amount of OLTP queries
- Very complex OLAP queries
- External Consistency
- SQL is much more complex than KV

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Why TiDB choose Golang?

- Easy-learning
- Productivity
- Concurrency
- Easy to trace bugs and profile
- Standard libraries and tools
- Tolerant GC latency
- Good performance
- Quick improvement

Go in TiDB

- More than 160K lines of Go code and 138 contributors.

```
github.com/AlDanial/cloc v 1.72  T=4.00 s (137.4 files/s, 52274.8 lines/s)
-------------------------------------------------------------------------------
Language                     files          blank        comment           code
-------------------------------------------------------------------------------
Go                             523          17655          18761         163173
yacc                             1            389            220           6236
XML                              7              0              0            999
JSON                             1              0              0            502
Markdown                         9            238              0            470
YAML                             3              6              4            227
make                             1             38              2            132
Bourne Shell                     3             12              5             52
Bourne Again Shell               1              9             18             47
Dockerfile                       1              5              0              8
-------------------------------------------------------------------------------
SUM:                           550          18352          19010         171846
-------------------------------------------------------------------------------
```

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Memory && GC

- Query may touch a huge number of data.
- Memory allocation may cost a lot of time.
- Put pressure on GC worker.
- Degrade the performance of SQL.
- OOM sucks!
- runtime.morestack

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Reduce the Number of Allocation

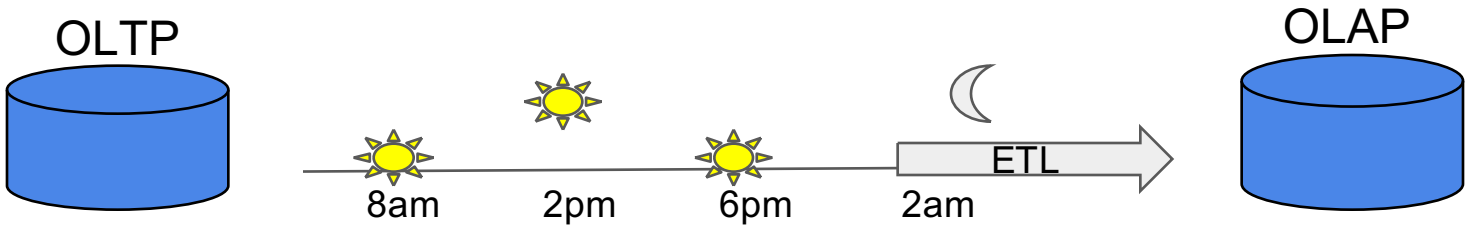
- Get enough memory in one allocation operation

```
a := []int{1, 2, 3, 4, 5}
b := []int{}
// a much better way:
// b := make([]int, 0, len(a))
for _, i := range a {
        b = append(b, i)
}
```

Reuse Object

- Share a stack for all queries in one session
- Introduce a cache in goyacc
- Resource pool

OLTP & OLAP

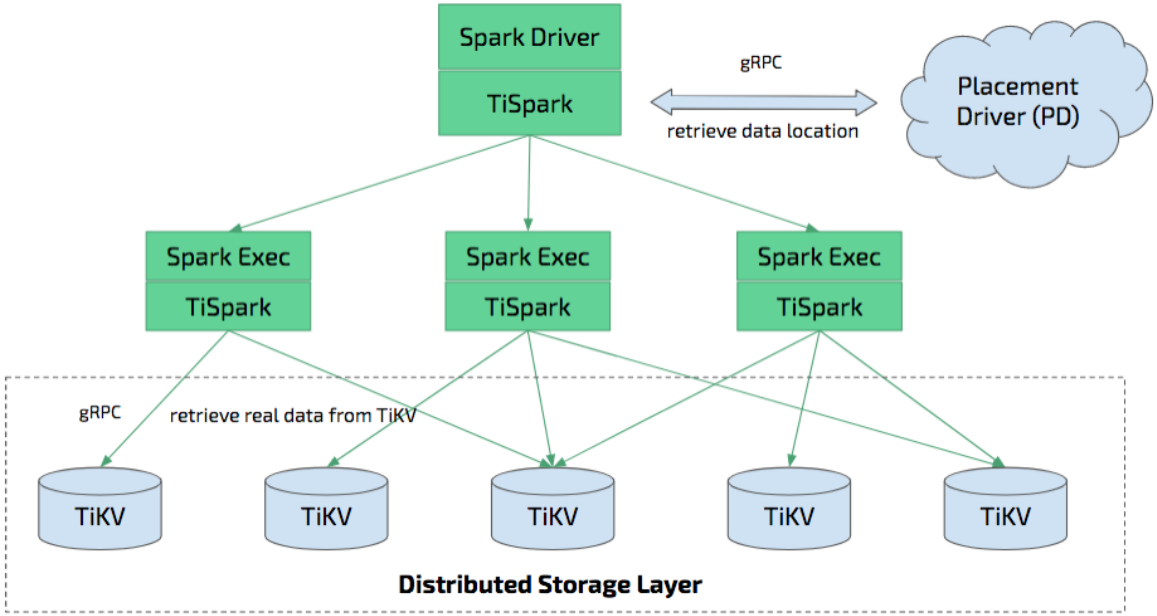


Database

Is the data out-of-date?

Data Warehouse

TiSpark


Spark Driver
TiSpark
gRPC
retrieve data location
Placement Driver (PD)
Spark Exec
TiSpark
Spark Exec
TiSpark
Spark Exec
TiSpark
gRPC
retrieve real data from TiKV
TiKV
TiKV
TiKV
TiKV
TiKV
Distributed Storage Layer

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Thanks!