GIAC | BEIJING Dec.12.16-17

架構 ARCHNOTES 高可用架构

技术架构未来

thegiac.com

360 redis 生态圈

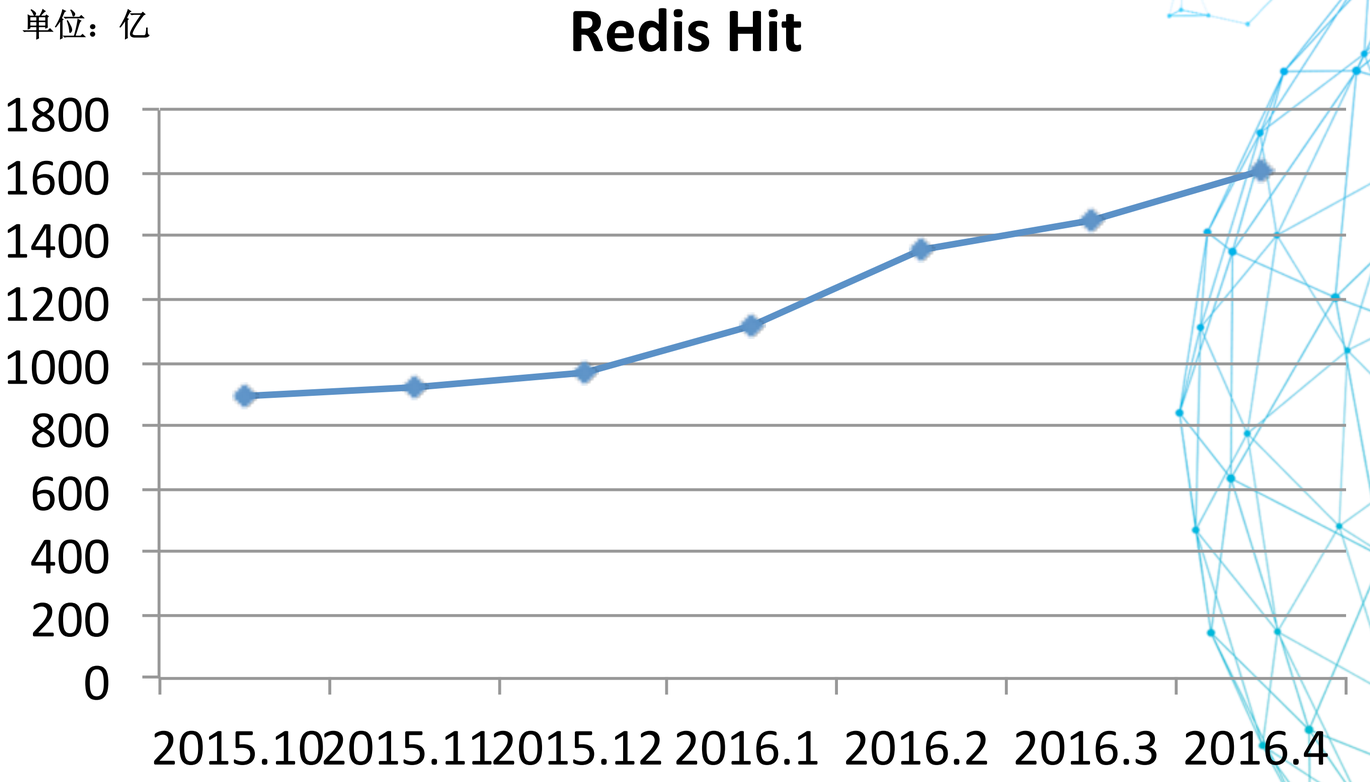
陈宗志

Introduce

- 13年入职 360 基础架构组
  - Bada
  - Pika
  - Zeppelin
  - Mario, Pink, slash, floyd
- https://github.com/Qihoo360

简介

- redis
- pika
- redis-cluster

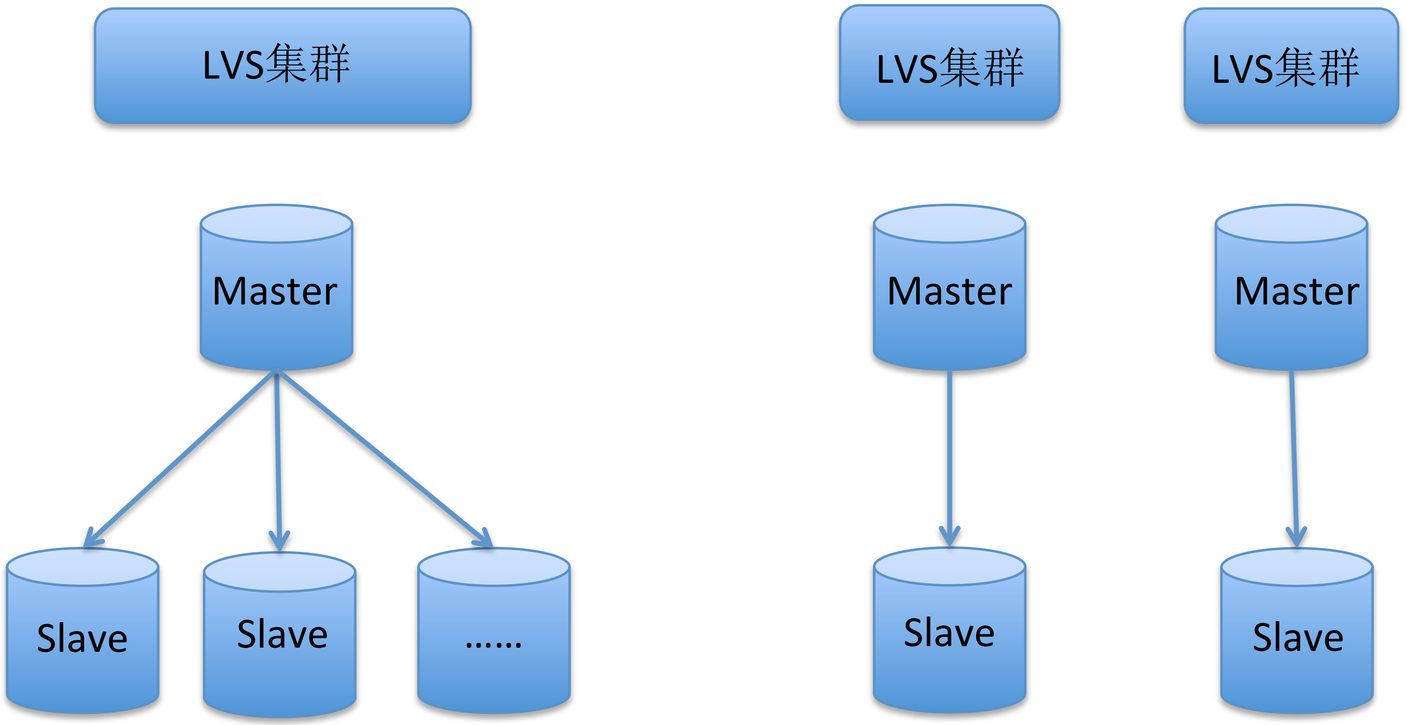

单位：亿
Redis Hit
1800
1600
1400
1200
1000
800
600
400
200
0
2015.10
2015.11
2015.12
2016.1
2016.2
2016.3
2016.4

redis

redis

- 高性能读写
  - 单线程读写 qps 10w/s
- 多数据结构
  - 支持string, hash, list, set, zset, HyperLogLog, Geo 等等
- 持久化
  - RDB, AOF
- 高可用
  - Master-slave(sentinel)
- 事务支持
- 自动过期

redis


LVS集群
LVS集群
LVS集群
Master
Master
Master
Slave
Slave
……
Slave
Slave

redis

- 场景
  - 高性能
  - 小数据量
  - 缓存, 持久化

redis

- 业务端
  - 读写分离
  - hash 分片

Pika

pika

- pika 是 DBA 和 Bada 团队一起设计开发的大容量 Redis 的解决方案
- 完全兼容 redis 协议, 用户不需要修改任何代码进行迁移

Pika

- 大容量redis 问题
- Pika 架构
- Pika 实现

Pika

- 恢复时间长
  - 50G redis 回复时间70分钟
  - 同时开启aof 和 rdb

Pika

- 一主多从, 主从切换代价大
  - 主库挂掉后升级从库, 所有的从库全部重传数据

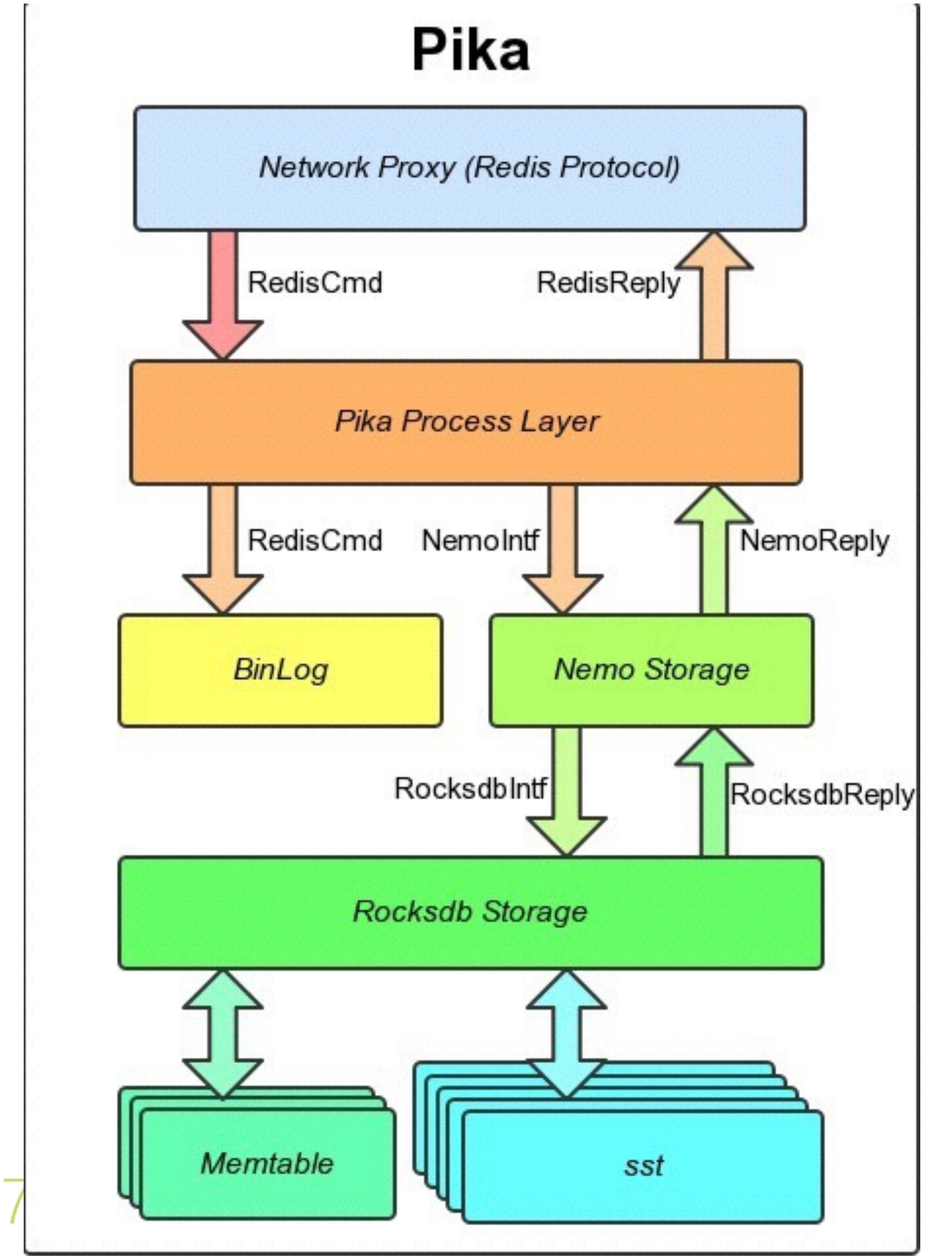
Pika

- 缓冲区写满问题
  - 内存是昂贵资源, 缓冲区一般设置2G
  - 网络原因很容易将数据堵死, 那么就会发生大量数据重传

Pika

- 内存价格昂贵
  - 我们一般线上使用的 redis 机器是 64G, 96G. 我们只会使用80% 的空间.
  - 如果一个 redis 的实例是50G, 那么基本一台机器只能运行一个 redis 实例. 因此特别的浪费资源

Pika 架构


Pika
Network Proxy (Redis Protocol)
RedisCmd
RedisReply
Pika Process Layer
RedisCmd
NemoIntf
NemoReply
BinLog
Nemo Storage
RocksdbIntf
RocksdbReply
Rocksdb Storage
Memtable
sst

Pika

- pink
  - 基础架构团队开发网络编程库, 支持pb, redis等协议. 对网络编程的封装, 用户实现一个高性能的server 只需要实现对应的DealMessage() 函数即可
  - 抽象各种不同类型线程
    - DispatchThread
    - WorkThread
    - BGThread
  - https://github.com/Qihoo360/pink

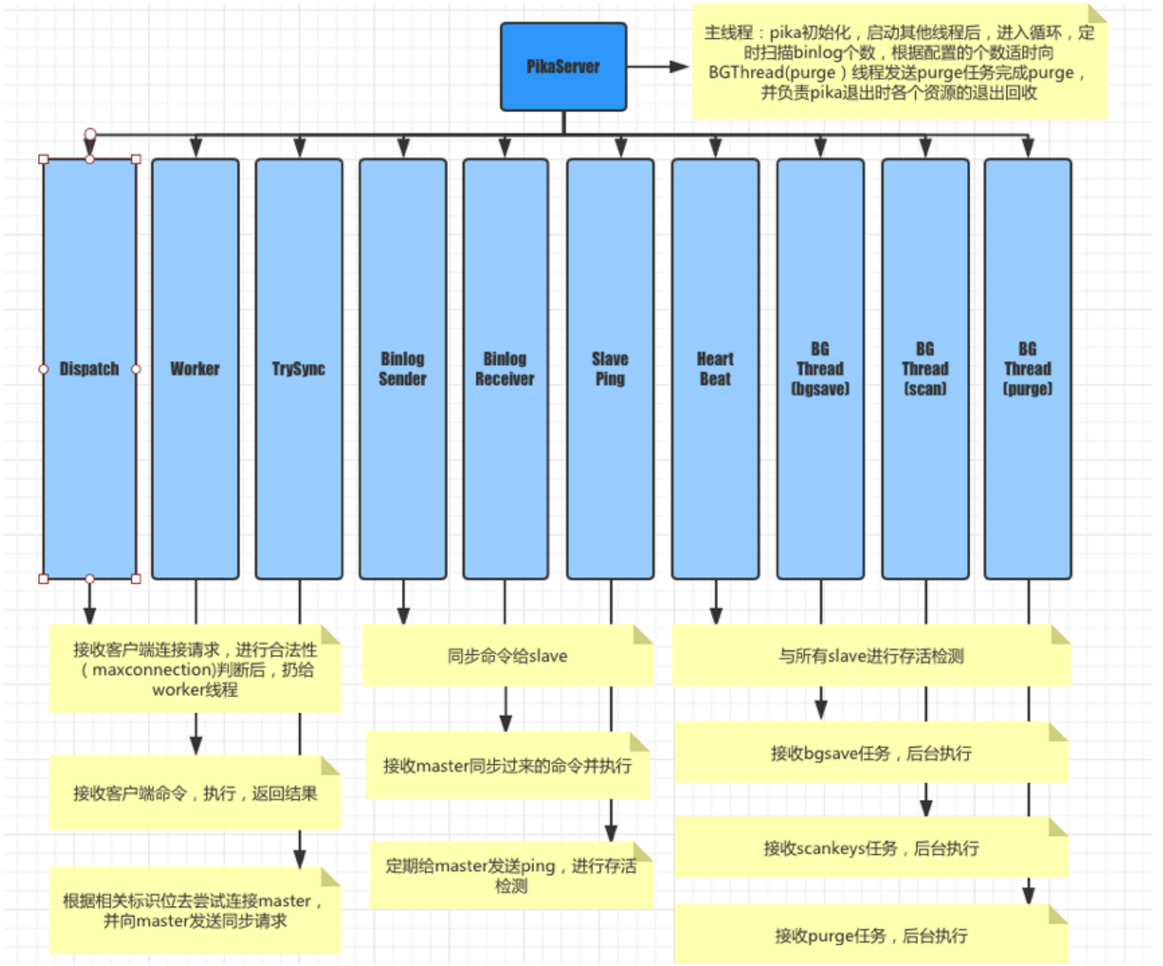
Pink

```
class MyPbConn : public pink::PbConn {
public:
  MyPbConn(int fd, std::string ip_port, pink::Thread* self_thread_ptr = NULL) : pink::PbConn(fd, ip_port) {
    res_ = dynamic_cast<google::protobuf::Message*>(&message_);
  }
  ~MyPbConn() {}
  int DealMessage() {
    message_.ParseFromArray(rbuf_ + cur_pos_ - header_len_, header_len_);
    message_.set_name("hello " + message_.name());
    uint32_t u =htonl( message_.ByteSize());
    memcpy(static_cast<void*>(wbuf_), static_cast<void*>(&u), COMMAND_HEADER_LENGTH);
    message_.SerializeToArray(wbuf_ + COMMAND_HEADER_LENGTH, PB_MAX_MESSAGE);
    set_is_reply(true);
  }
```

Pink

```
class MyWorkerThread : public pink::WorkerThread<MyPbConn> {
public:
  MyWorkerThread(int cron_interval = 0) : pink::WorkerThread<MyPbConn>(cron_interval) {}
  ~MyWorkerThread() {}
private:
  MyWorkerThread& operator=(MyWorkerThread&);
  MyWorkerThread(MyWorkerThread&);
};

 MyDispatchThread *dispatch_thread = new MyDispatchThread(my_port, my_worker_threads_num,
my_worker_threads_ptr, dispatch_cron_interval);
```

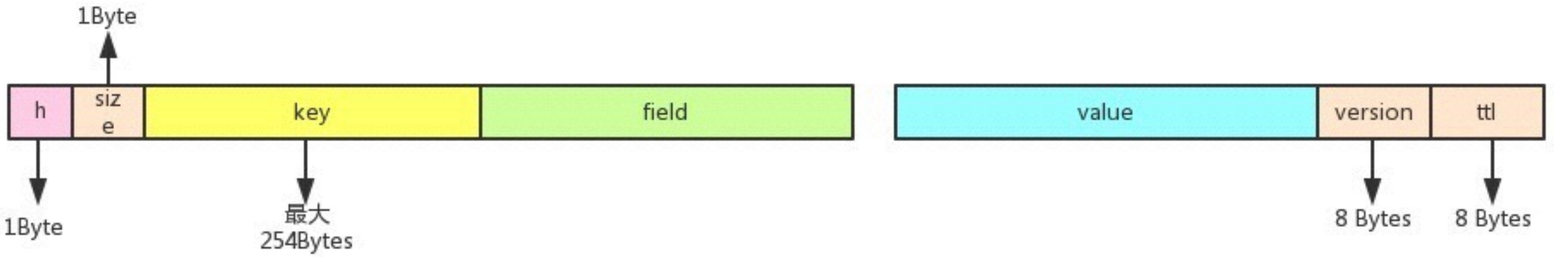

PikaServer
主线程：pika初始化，启动其他线程后，进入循环，定时扫描binlog个数，根据配置的个数适时向BGThread(purge）线程发送purge任务完成purge，并负责pika退出时各个资源的退出回收
Dispatch
Worker
TrySync
Binlog Sender
Binlog Receiver
Slave Ping
Heart Beat
BG Thread (bgsave)
BG Thread (scan)
BG Thread (purge)
接收客户端连接请求，进行合法性（maxconnection)判断后，扔给worker线程
接收客户端命令，执行，返回结果
根据相关标识位去尝试连接master，并向master发送同步请求
同步命令给slave
接收master同步过来的命令并执行
定期给master发送ping，进行存活检测
与所有slave进行存活检测
接收bgsave任务，后台执行
接收scankeys任务，后台执行
接收purge任务，后台执行

Pika

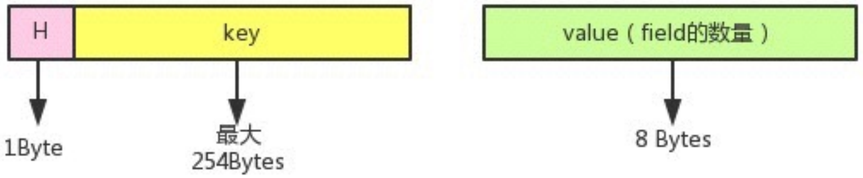
- nemo
  - pika 的存储引擎, 基于 rocksdb 实现. 实现了hash, list, set 等数据结构
  - rocksdb 启动只需要加载 log 文件
  - rocksdb 大量使用的本地磁盘
  - https://github.com/Qihoo360/nemo

Hash

a.每个hash键、field、value到落盘kv的映射转换



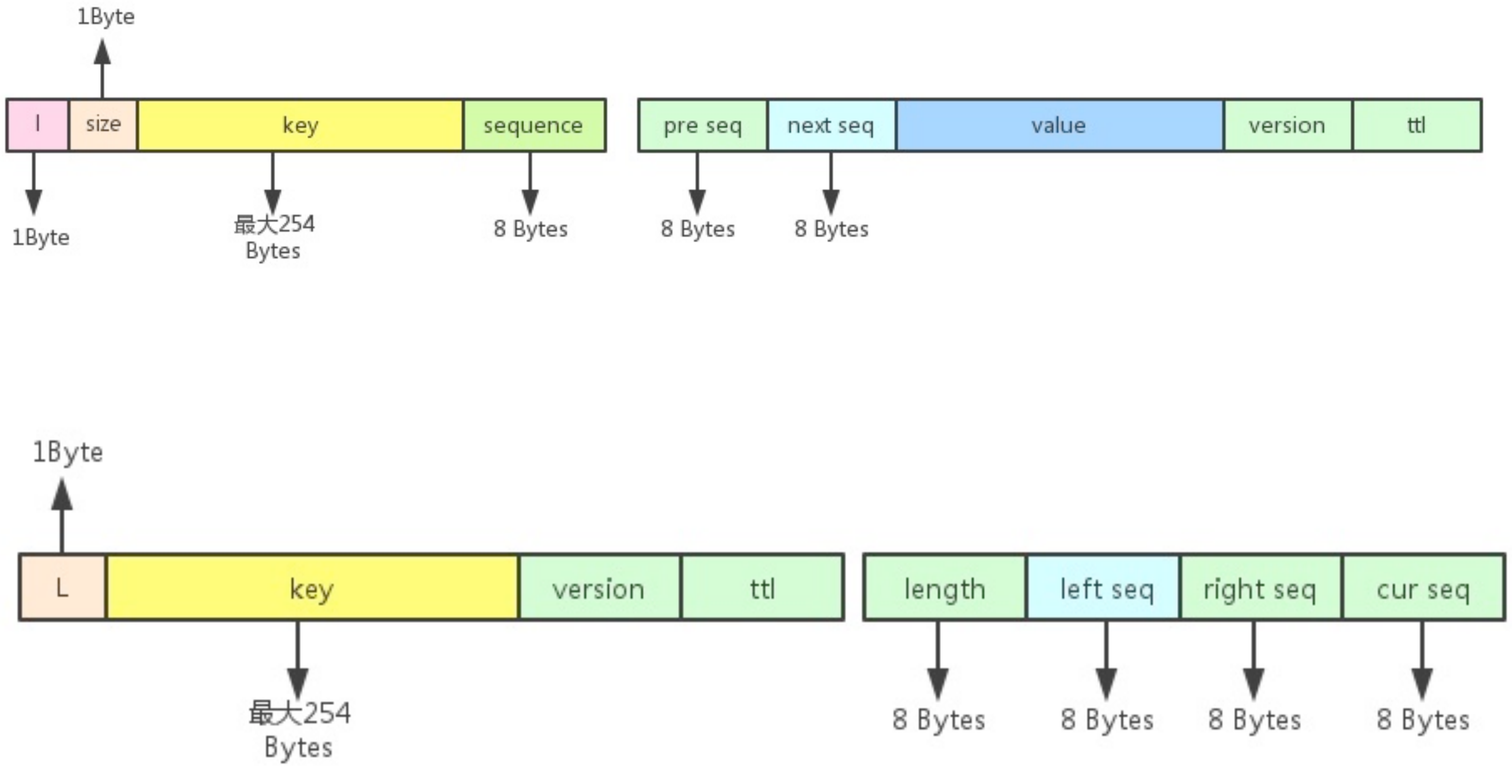
b.每个hash键的元信息的落盘kv的存储格式



Hash

- HSET myhash field1 "Hello"
  - DB->Put(wop, h6myhashfield1, Hello01477671118)
  - DB->Put(wop, Hmyhash11477671118, 6)

List


1Byte
l
size
key
sequence
1Byte
最大254 Bytes
8 Bytes
pre seq
next seq
value
version
ttl
8 Bytes
8 Bytes
1Byte
L
key
version
ttl
最大254 Bytes
length
left seq
right seq
cur seq
8 Bytes
8 Bytes
8 Bytes
8 Bytes

List

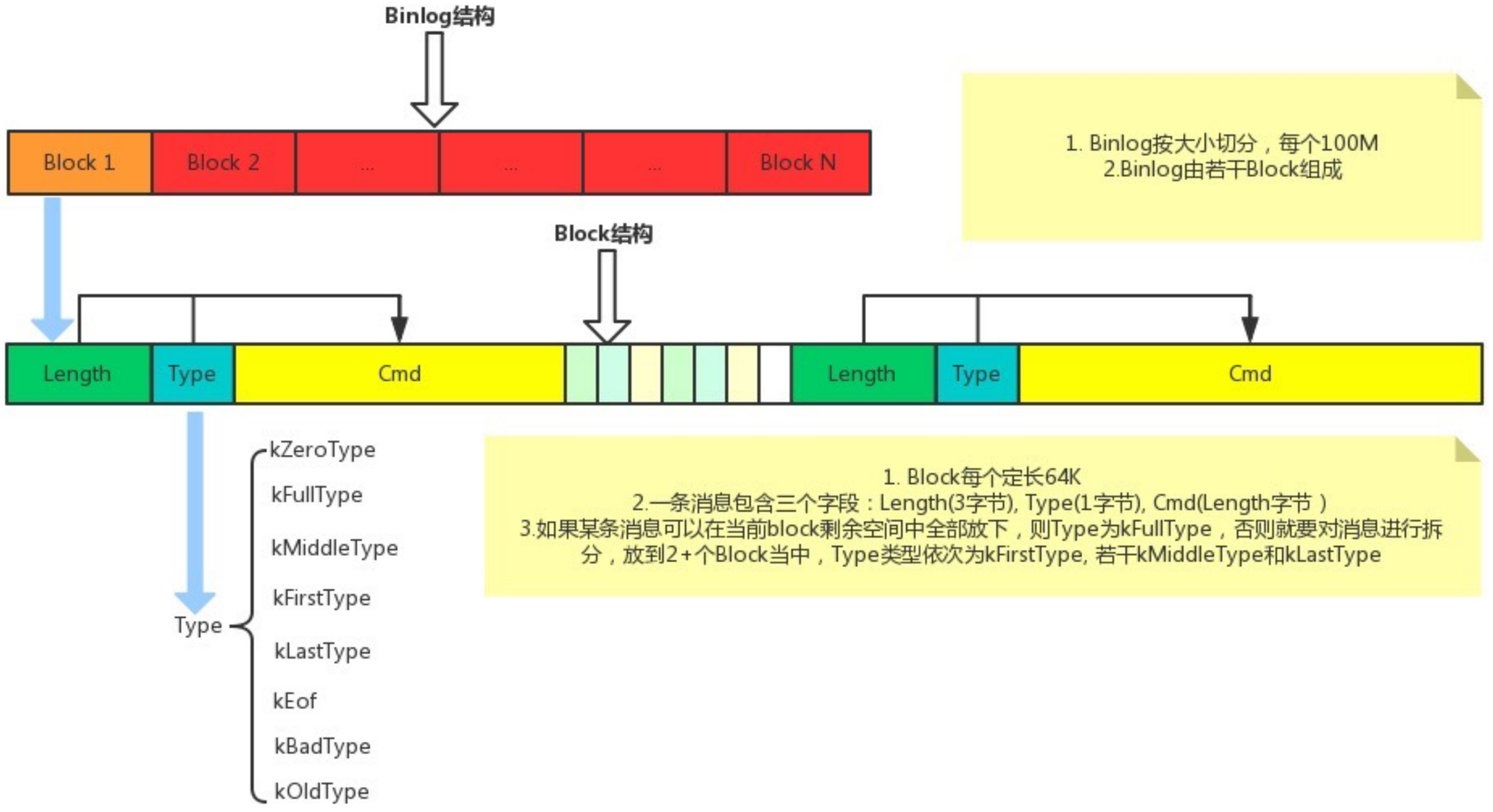
- LPUSH mylist “world"
  - DB->Put(wop, l6mylist6, 57world01477671118)
  - DB->Put(wop, Lmyhash11477671118, 6071)

Pika

- 主从结构
  - slaveof
  - binlog

Binlog

- 顺序写文件, 通过Index + offset 进行同步点检查
- 解决了缓冲区小的问题
- 支持全同步 + 增量同步


Binlog结构
Block 1
Block 2
...
...
...
Block N
1. Binlog按大小切分，每个100M
2.Binlog由若干Block组成
Block结构
Length
Type
Cmd
Length
Type
Cmd
Type
kZeroType
kFullType
kMiddleType
kFirstType
kLastType
kEof
kBadType
kOldType
1. Block每个定长64K
2.一条消息包含三个字段：Length(3字节), Type(1字节), Cmd(Length字节)
3.如果某条消息可以在当前block剩余空间中全部放下，则Type为kFullType，否则就要对消息进行拆分，放到2+个Block当中，Type类型依次为kFirstType, 若干kMiddleType和kLastType

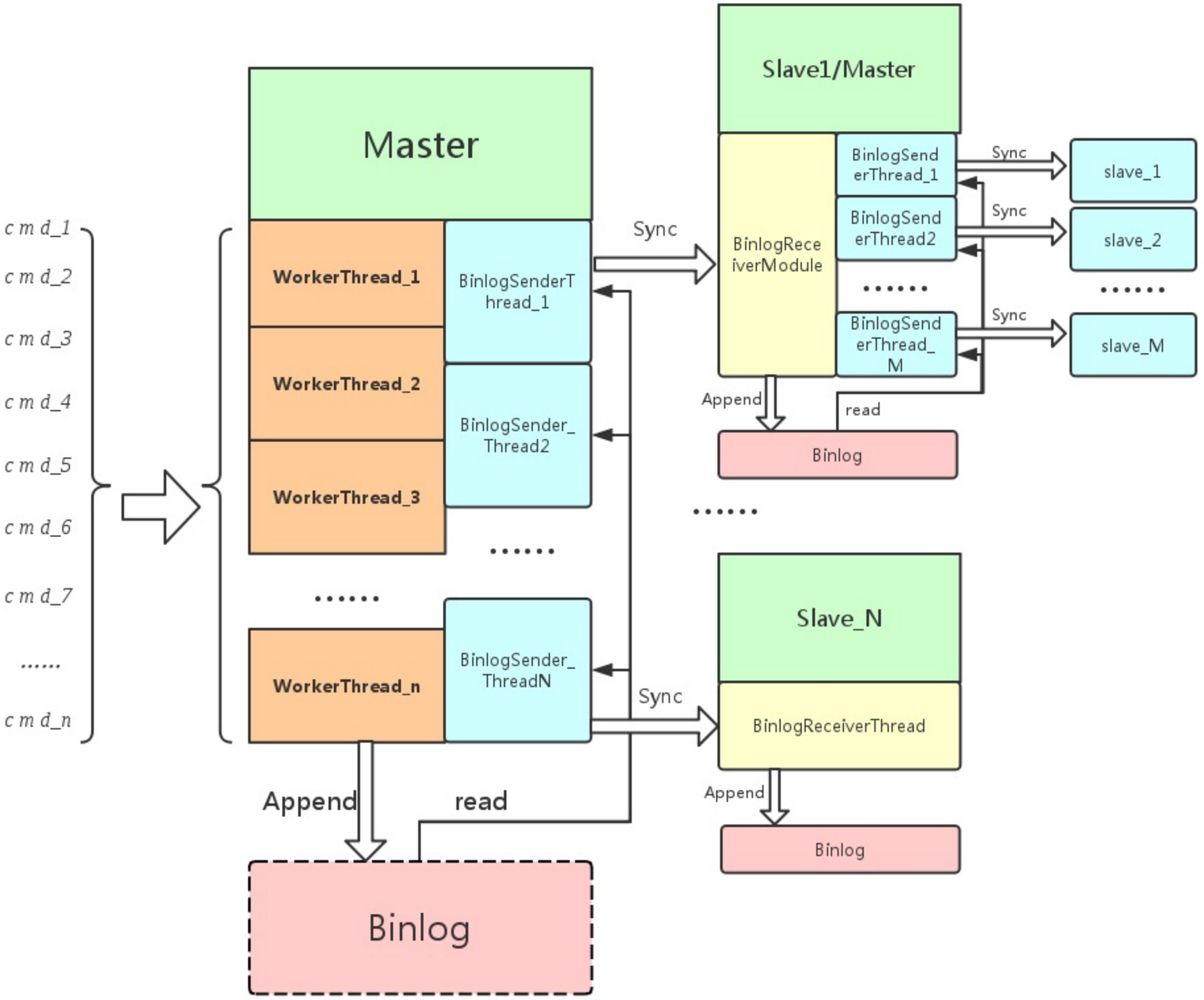
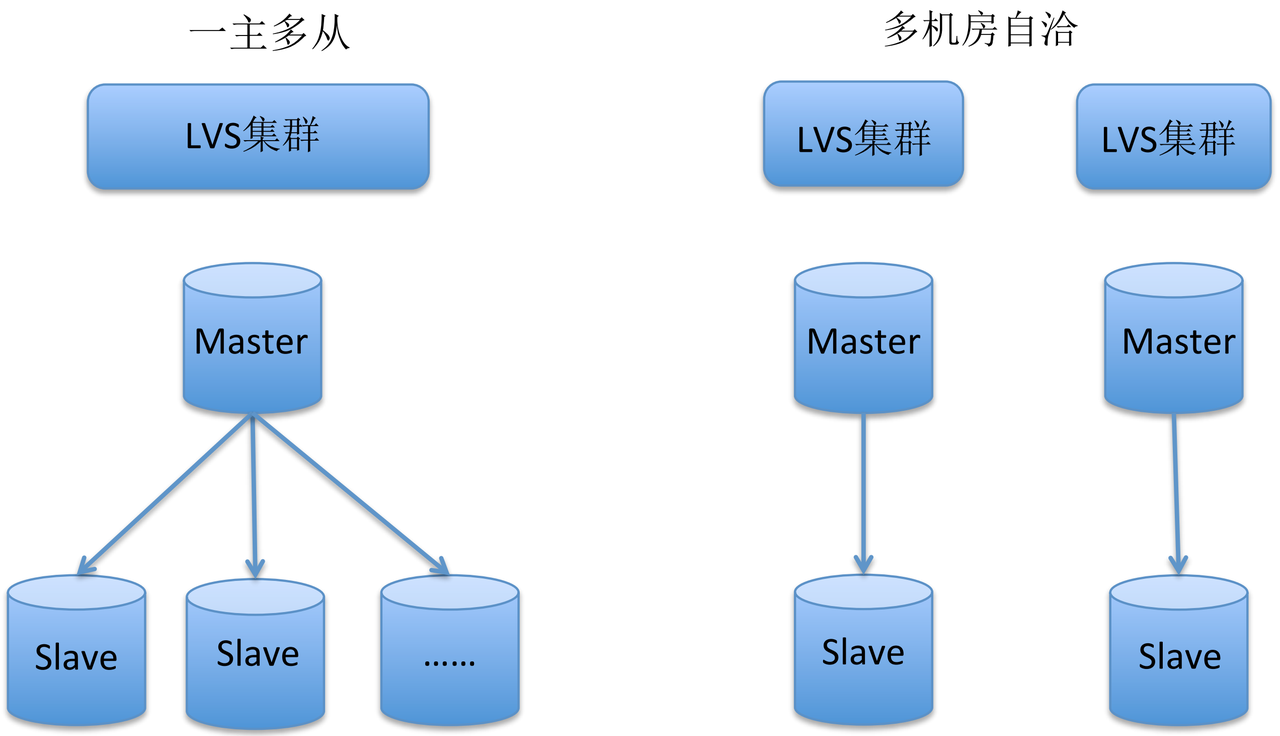


图1 Pika的主从命令同步框架图

Pika


一主多从
LVS集群
Master
Slave
Slave
.....
多机房自洽
LVS集群
LVS集群
Master
Master
Slave
Slave

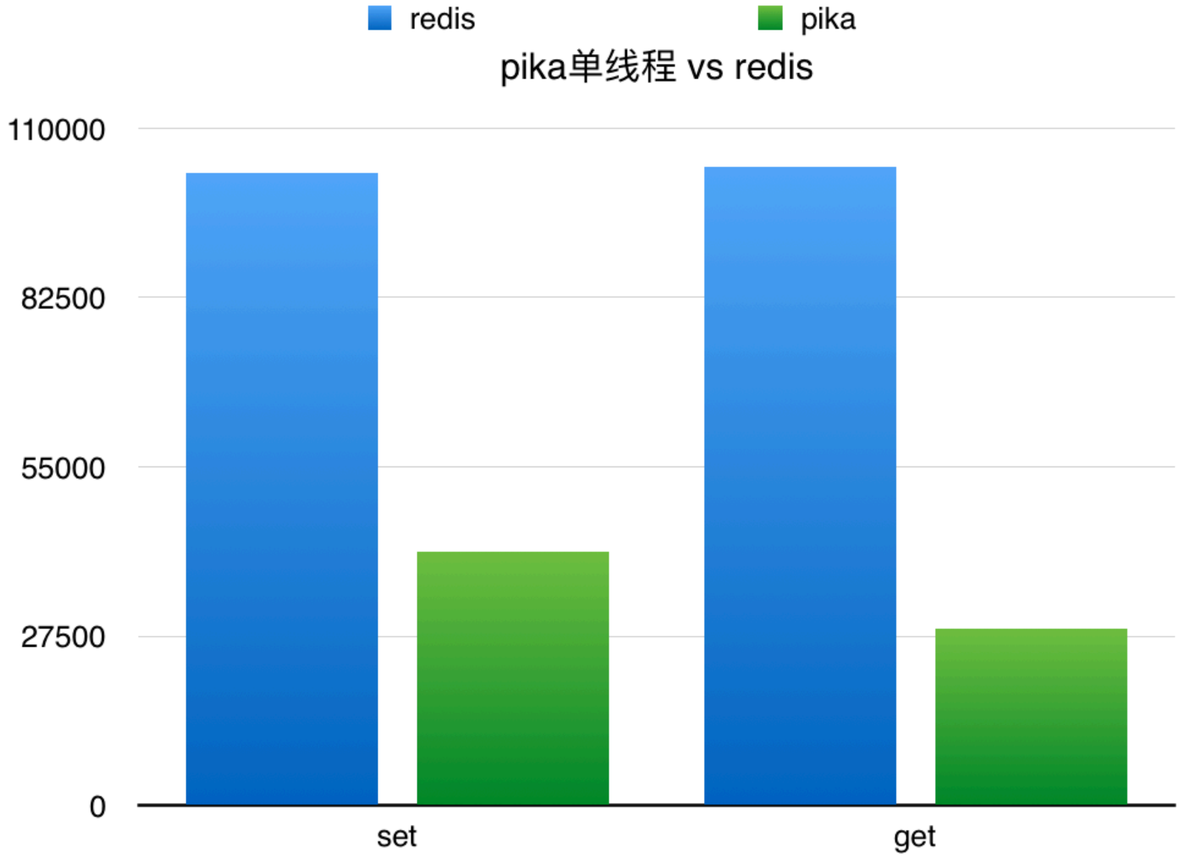
Pika

- 高性能
  - 多线程结构, 单节点重复利用多核. 单进程8w qps
- 低成本
  - 持久化存储数据在磁盘上, 基于Rocksdb 引擎, 性价比高
- 支持全同步, 半同步
  - 对网络容忍度更高
- 启动速度快

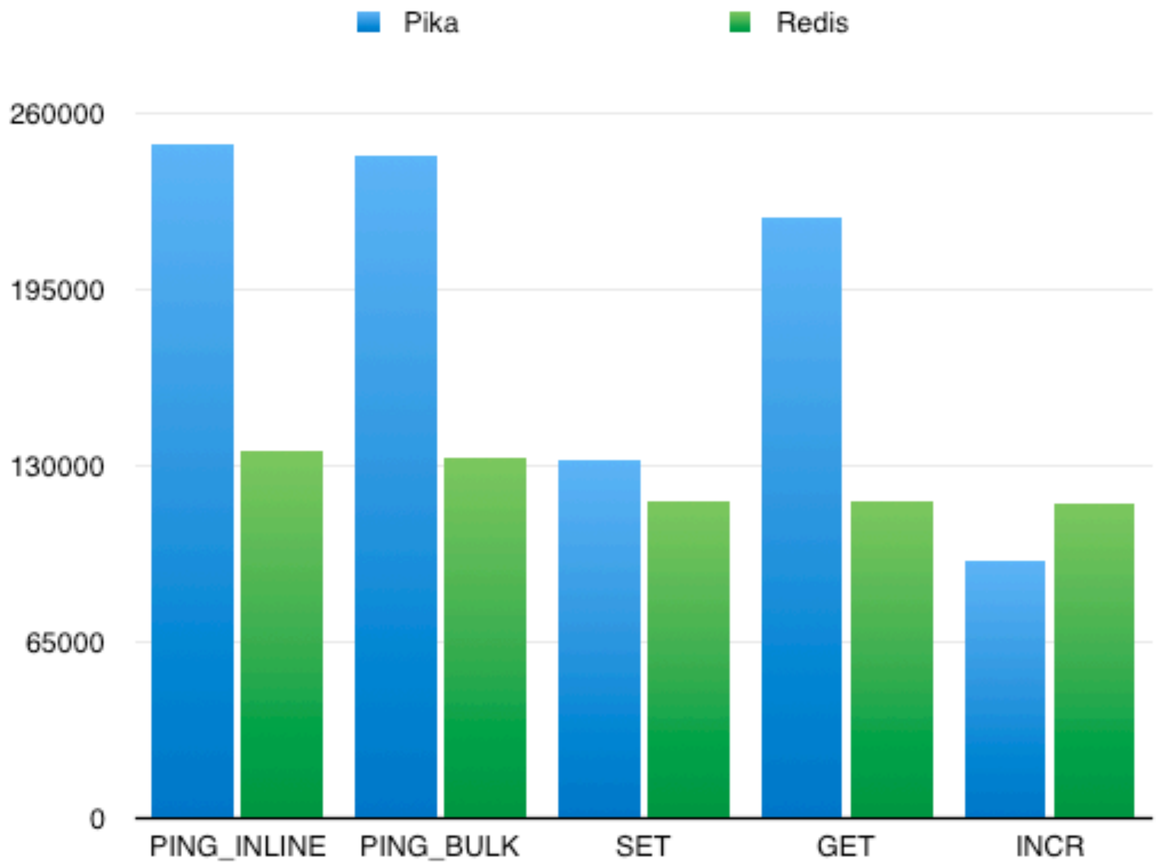
Pika

- 场景
  - 多数据结构
  - 持久化数据存储
  - 大容量

pika vs redis



pika vs redis



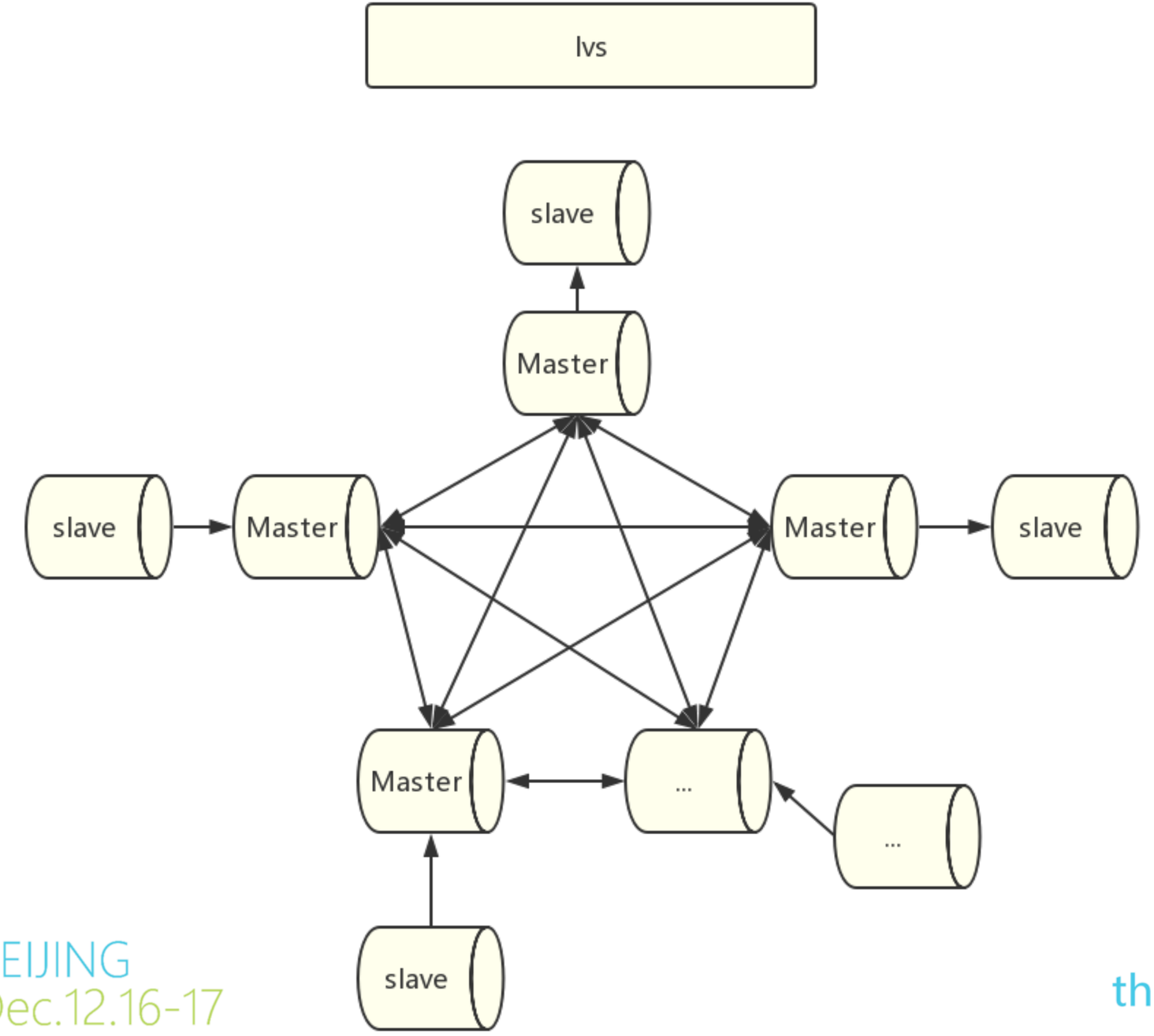
wiki

- https://github.com/Qihoo360/pika/wiki

redis-cluster

redis-cluster

- 无中心节点
- 数据分布 Hash slot
- 主从副本 最终一致性
- failover gossip


lvs
slave
Master
slave
Master
Master
slave
Master
...
...
slave

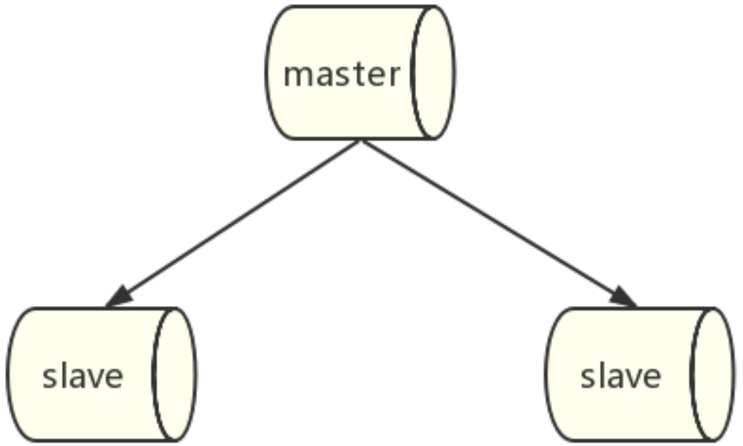
Hash slot

- Node A contains hash slots from 0 to 5500.
- Node B contains hash slots from 5501 to 11000.
- Node C contains hash slots from 11001 to 16383.

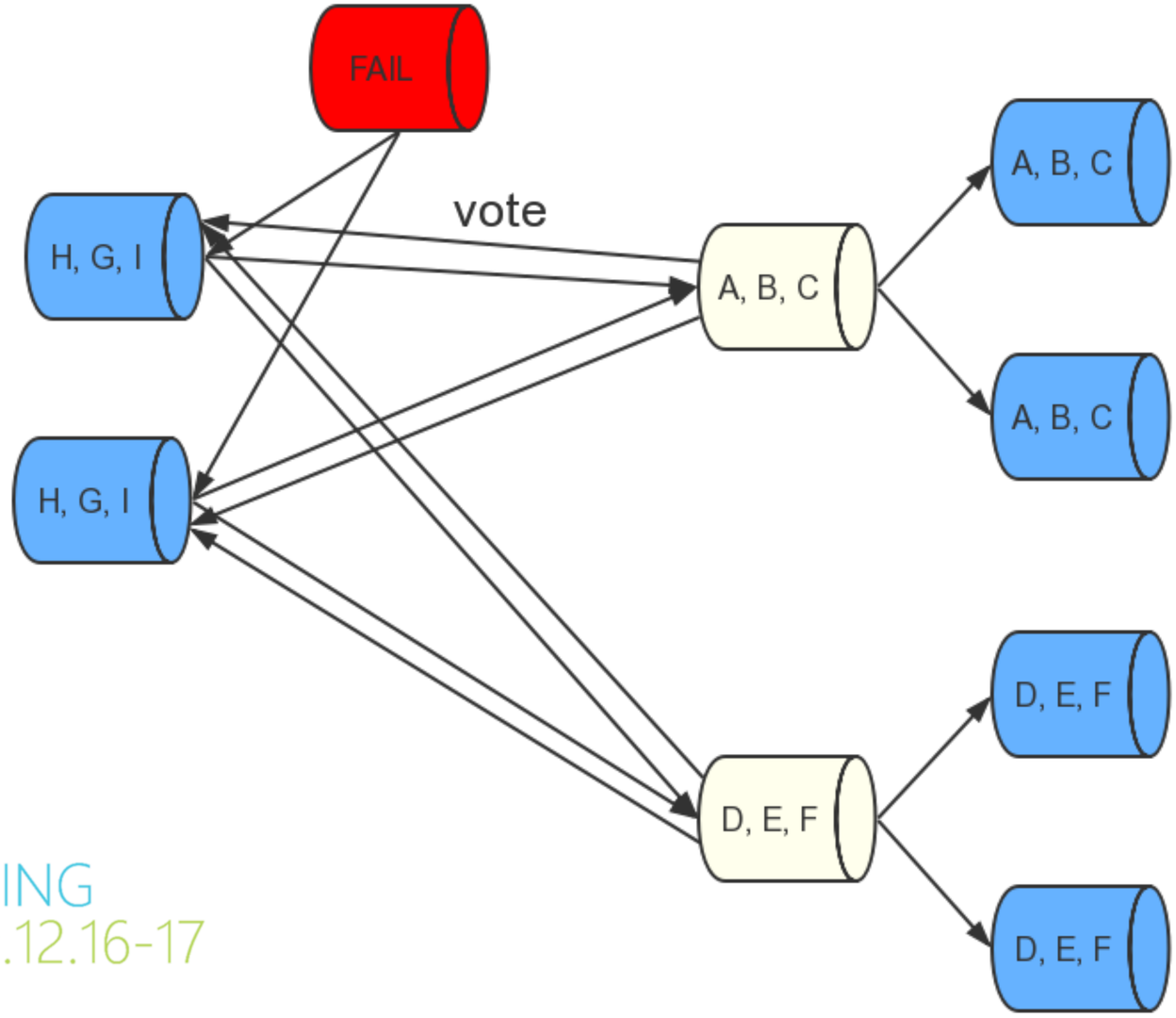
Hash-slot

```
cluster nodes
$6865
c4a4f66771d2ed0a10960963c28988b7194e51e0                 l6999 master - 0 1477560407533 74 connected 2048-2347
949eddf054b7364c95bfd2f79f64aee5f01c821d                 l6999 master - 0 1477560417533 63 connected 1000-1341 3070-3071 14336-14675
f253d5f3ae0ccc735cab424a343ca2bf578f5d9a                 l6999 master - 0 1477560410534 61 connected 3072-3413 15360-15701
29021cb07c9508747cb4e22068ffc187258ebcac                 :16999 master - 0 1477560435534 41 connected 14676-15357
6e9aaff11ef70d483a362acb665a2ea5e8bbf9c9                 :16999 master - 0 1477560392527 39 connected 8532-9213
4b780db69f56f366a924f67ee2da0cec12c42601                 :16999 slave 091614c3461f58c32c40bade4251accef4b5e24d 0 1477560402532 20 connected
2a3e0197f2cf923b274dab7109411db2eb64c54a                 :16999 slave 43a68252e445fd630831c035d07236e3cbee9d43 0 1477560425534 42 connected
90f7c96ded0733d8bc0237cab7928db062020d54                 5999 slave c4a4f66771d2ed0a10960963c28988b7194e51e0 0 1477560405534 74 connected
682a77c2179efe31cf42d9180adf11286c77dc08                 :16999 master - 0 1477560436534 60 connected 5120-5461 11264-11605
aa8c87002f66742d20ee312b087f295da9af0c0a                 :16999 slave 9de4e976c82fa76f3939eb725b0bcd639d3605ce 0 1477560431534 37 connected
e2d90136f1aacf1b3c044bd5bcb674f859a67ba8                 :16999 slave 5f2a19e5c8ffe5ee73a4556c5b3ef6716cd4f12c 0 1477560415533 11 connected
a28c8abf26e299ca889e4dff3d06b92598465ec8                 :16999 slave eb94a47331be34481db5c6ab403be8d6d2f1508b 0 1477560421533 43 connected
5dd5958c20fda085ef004b84dccf8e36f32ecef5                 l6999 slave f79ea0890cc21b5bcc5f95468b34a0625319cb42 0 1477560420533 67 connected
02aa432b5909b6bf3ff1b44c4a0616f8df245e2e                 l6999 master - 0 1477560417534 64 connected 4394-4437 10240-10579
b7e2d6dd82837a5d6ee2122b3e5c32322fee6c5c                 l6999 slave a7b77c5cbbef296b4807432a251c7663cd9956ff 0 1477560418533 62 connected
2ff4a742549b489d39627b31f5245590984a8003                 :16999 slave a6afef602a10e45e931a13abd21671e2a4b7079b 0 1477560396529 18 connected
2f6b6e904ff77c178e8033b14deeccc64a516bad                 l6999 slave 7905a7ab10d14674c2d8df8a59682f6f0581c7ef 0 1477560404534 69 connected
43a68252e445fd630831c035d07236e3cbee9d43                 :16999 master - 0 1477560424534 42 connected 642-999 13290-13311 15358-15359
ad28b24686f7605a3c8a1615c798ed05dff4d3a2                 l6999 slave 02aa432b5909b6bf3ff1b44c4a0616f8df245e2e 0 1477560402532 64 connected
6722b98702ad6398bbef3bf6f56c68d299d3406d                 l6999 slave c55c9482c83d462936c44277a238631ace58a8c0 0 1477560403532 73 connected
7905a7ab10d14674c2d8df8a59682f6f0581c7ef                 l6999 master - 0 1477560430534 69 connected 2023-2024 4096-4393
87f3a4c2f5a5b6232358e0f4000f74ce0b7ac0c9                 :16999 slave 64b917470d686ec32cae3d26c73f33d03629aa11 0 1477560412533 19 connected
1979a5c341e5fb27fd3daf9aea152eeb1cd79d7f                 :16999 slave 85f94f62955d37e6dbe4a9a137ebeb8b0ce89db1 0 1477560438535 1 connected
a7b77c5cbbef296b4807432a251c7663cd9956ff                 l6999 master - 0 1477560441536 62 connected 7169-7510 9216-9557
091614c3461f58c32c40bade4251accef4b5e24d                 :16999 master - 0 1477560443539 20 connected 13654-14335
f79ea0890cc21b5bcc5f95468b34a0625319cb42                 l6999 master - 0 1477560414533 67 connected 2348-2389 5118-5119 8192-8531
85f94f62955d37e6dbe4a9a137ebeb8b0ce89db1                 :16999 master - 0 1477560440535 1 connected 3414-4095
89db9f2e08fc9a2c2734ada63dee227ff3d8266f                 :16999 slave 1af7ddc8b6b5eaf3e6d3160e65501246af1479d2 0 1477560418533 13 connected
969e9b323995a99db0fe573097a91b1beb49cfde                 :16999 master - 0 1477560427534 36 connected 1342-2022 7168
feb092298bfcc295f595f5f758600d6a3d172333                 :16999 slave 969e9b323995a99db0fe573097a91b1beb49cfde 0 1477560406533 36 connected
cc6e96ef996f05c0bb3313f0f02c82a317917e10                 :16999 slave 6e9aaff11ef70d483a362acb665a2ea5e8bbf9c9 0 1477560415533 39 connected
50a9aeec9e8d62395033d639a8a66eed41d9adfc                 :16999 slave cb4e5ef2e1b1f51bb0159b72177ecd694d2b415d 0 1477560423533 44 connected
cb4e5ef2e1b1f51bb0159b72177ecd694d2b415d                 :16999 master - 0 1477560398529 44 connected 2390-3069 9214-9215
72cc3e59a88138b94628830ffe993a3d8592090f                 l6999 slave 92456c06e5feb93f33f6eefe2642770ad15c4365 0 1477560428534 66 connected
eb94a47331be34481db5c6ab403be8d6d2f1508b                 l6999 master - 0 1477560395529 43 connected 4438-5117 11262-11263
```

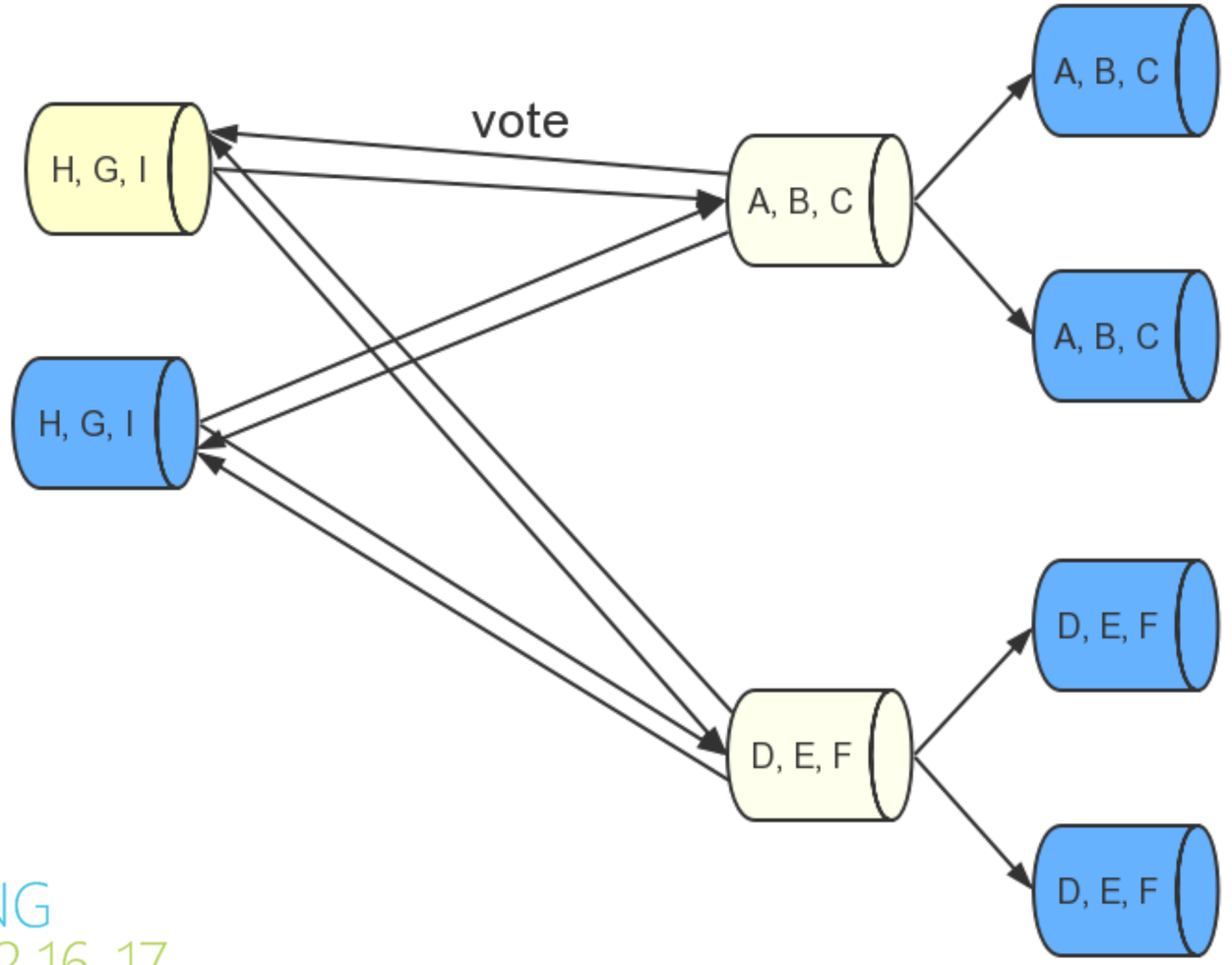
redis-cluster



failover



failover



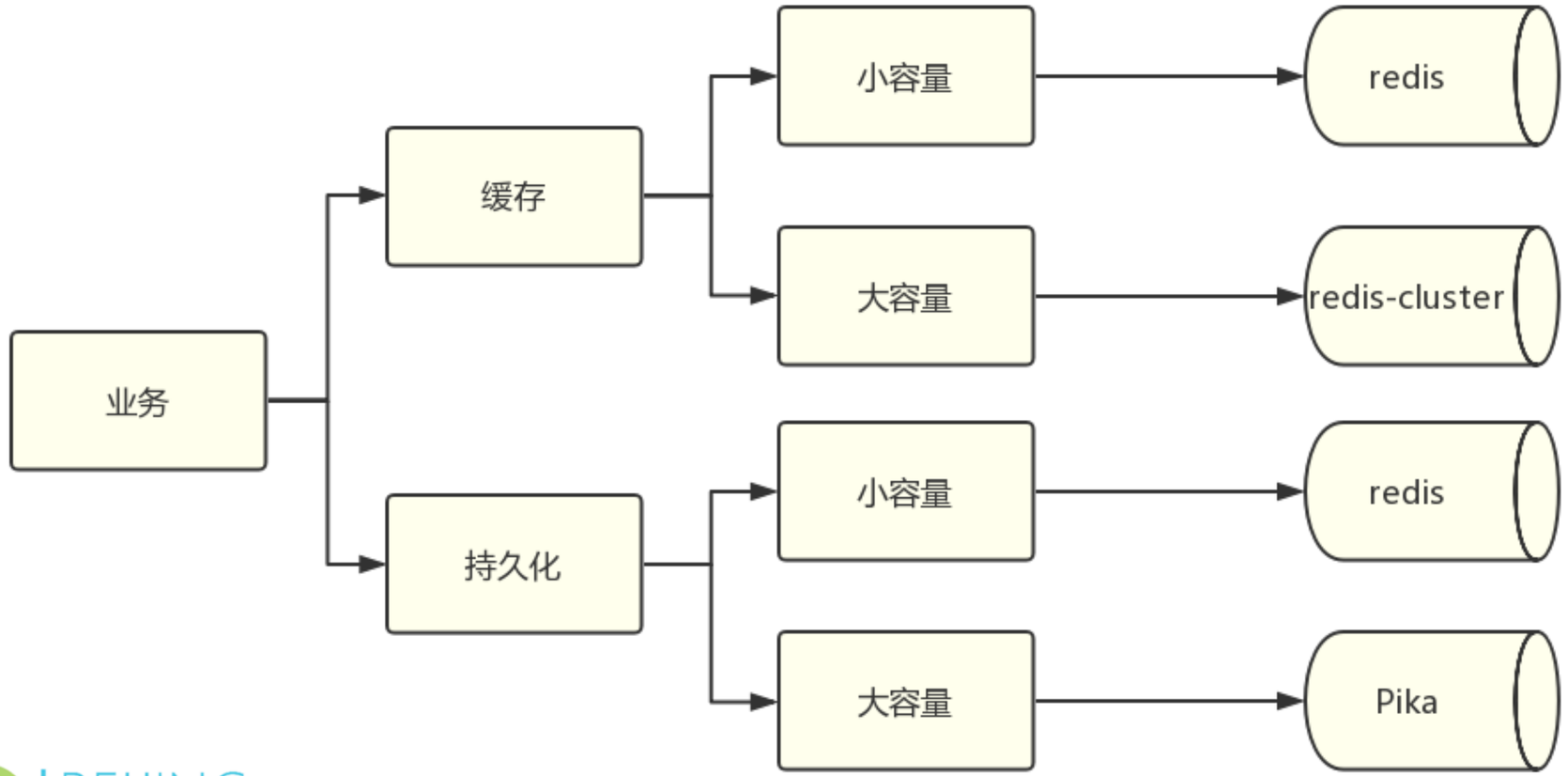
redis-cluster

- 场景
  - 纯缓存
  - 大容量
  - 高并发
  - 高增长

redis vs pika vs redis-cluster

	redis	Pika	redis-cluster
线程数	单线程	多线程	单线程
性能	10w+ qps	8w+ qps	线性增长
存储方式	缓存,持久化	持久化	纯缓存
架构	主从	分布式+HA	主从
场景	小容量, 缓存/持久化	纯缓存, 高性能	大容量, 持久化

summary



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技术架构未来

架構 ARCHNOTES 高可用架构

Thank you!