分布式行情推送系统

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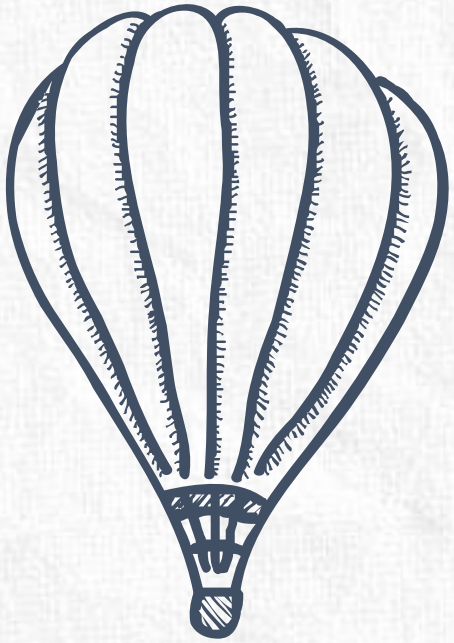
xiaorui.cc

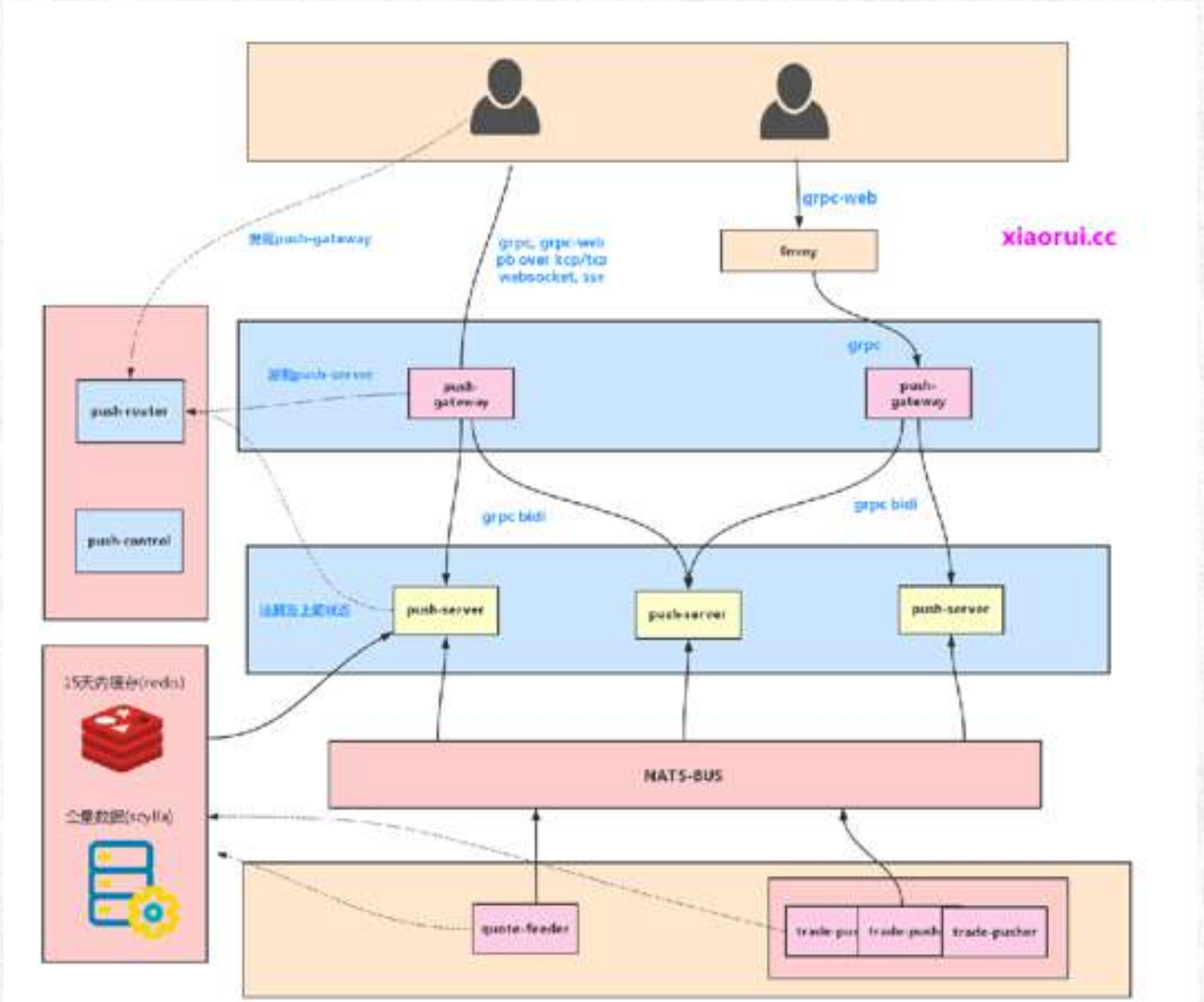
github.com/rfyiamcool

CONTENT



架构设计

推送集群架构


grpc-web
xiaorui.cc
grpc, grpc-web
pb over tcp/tcp
websocket, sse
push-router
push-control
push-gateway
push-gateway
grpc
grpc bidi
grpc bidi
push-server
push-server
push-server
NATS-BUS
quote-feeder
trade-pusher

组件介绍

- push-router
  - 服务发现注册及调度
- push-gateway
  - 鉴权及协议转换
  - 支持websocket, grpc, grpc-web, kcp
- push-server
  - 业务逻辑, 维护订阅关系及缓存
- push-control
  - 集群管理
- nats-bus
  - 消息总线

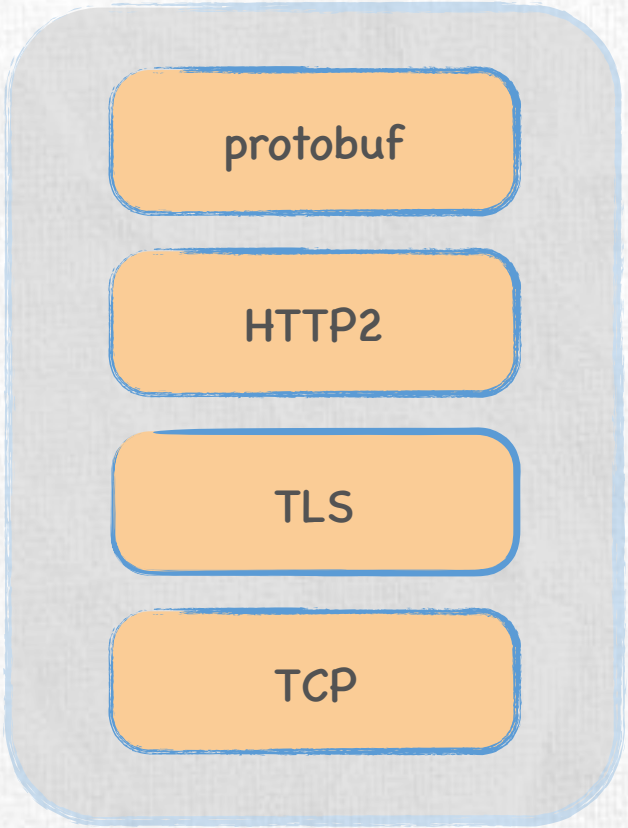
技术选型

- golang
- proto
  - grpc
  - envoy -> grpc-web
  - websocket
  - pb over tcp
  - pb over kcp
  - json
  - protobuf
- mq
  - nats-stream
- cache
  - redis
- database
  - scylla

技术选型

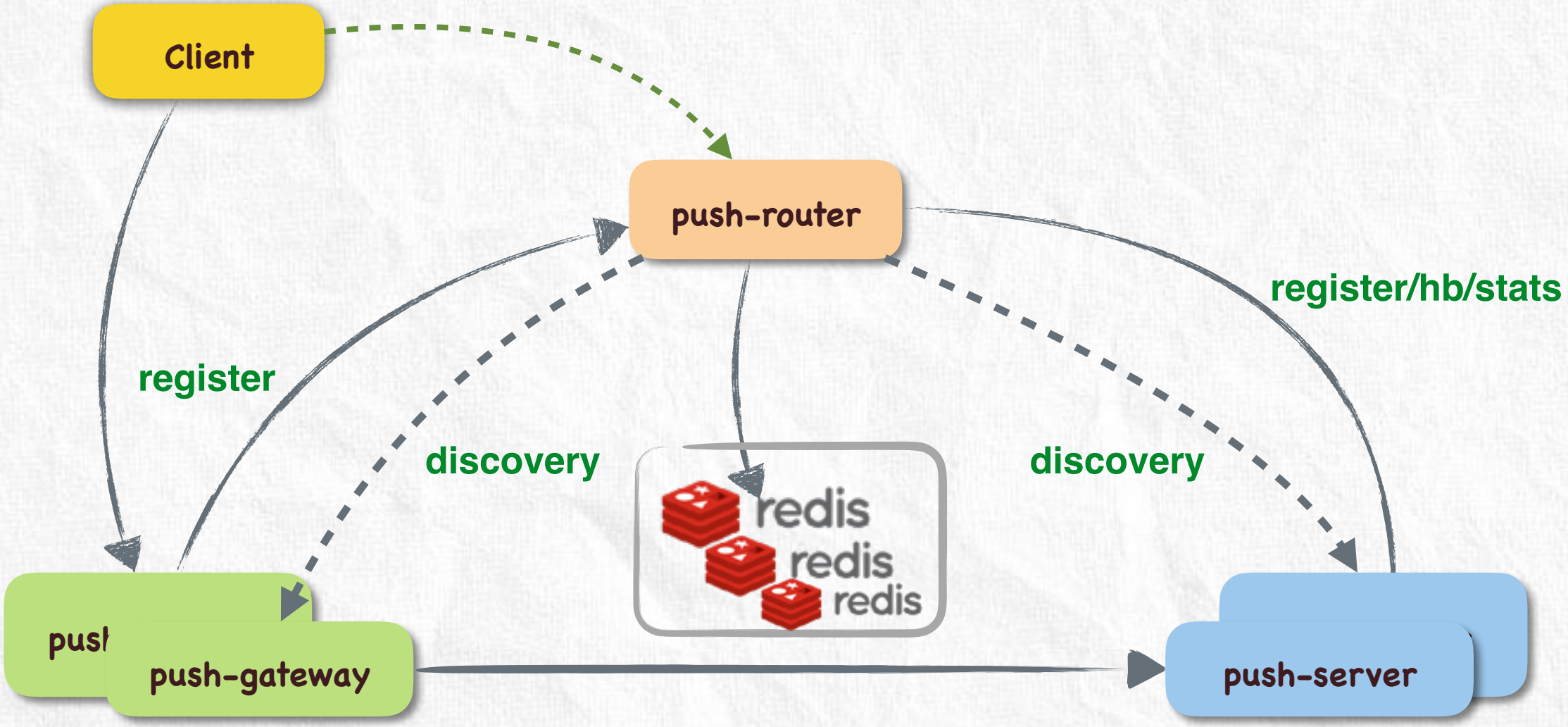
- grpc
  - 内部量化
- grpc-web
  - web前端
- websocket
  - 供外部量化api
- 移动端
  - pb over tcp
  - pb over kcp ...

grpc

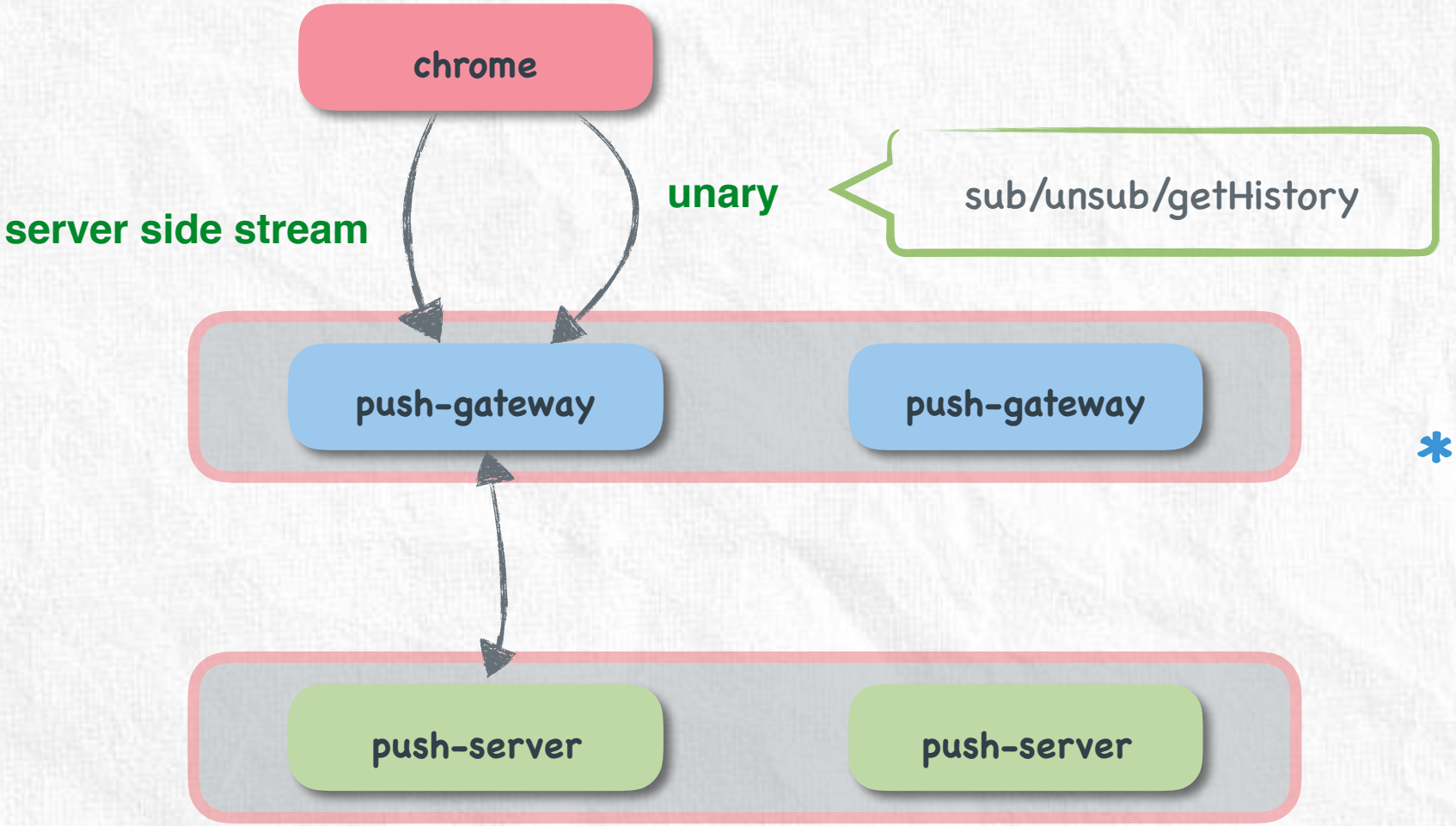


- 优点
  - 支持各类语言
  - 基于http2兼容好
  - 支持bidi全双工通信模式
  - protobuf
    - 高性能序列化
    - 压缩

服务注册发现


Client
push-router
register/hb/stats
register
discovery
discovery
redis
redis
redis
push-gateway
push-server

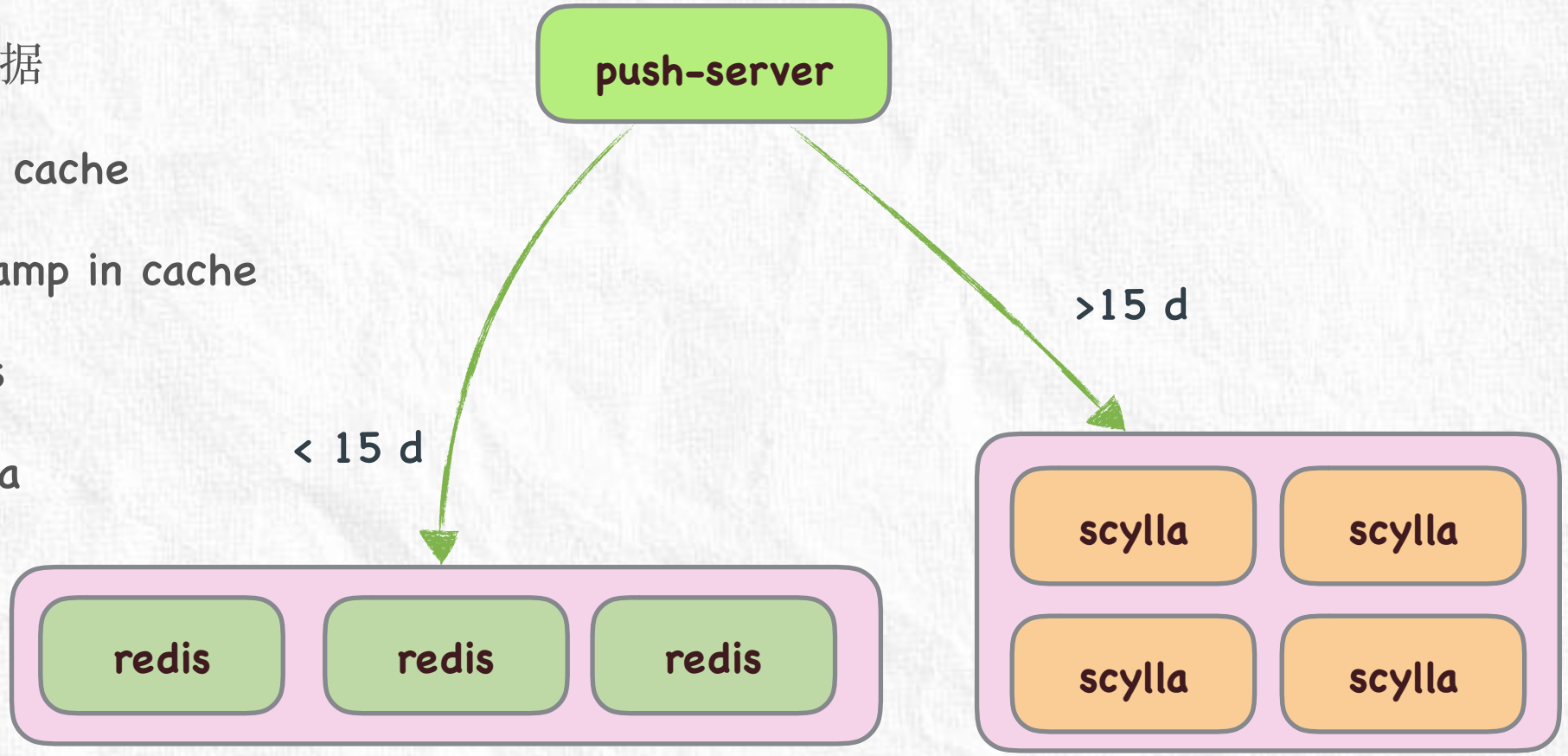
grpc-web in fe



* 😅 不支持grpc bidi模式

多级缓存

- push-server
  - 初始化缓存数据
  - expire 24h in cache
  - query timestamp in cache
  - < 15d in redis
  - > 15d in scylla



性能优化

推送优化

- 当某个topic的订阅者超过一个量级
  - 并发触发会更快
  - 协程池有效减少栈扩充消耗
  - 切chunk可减少协程池调度

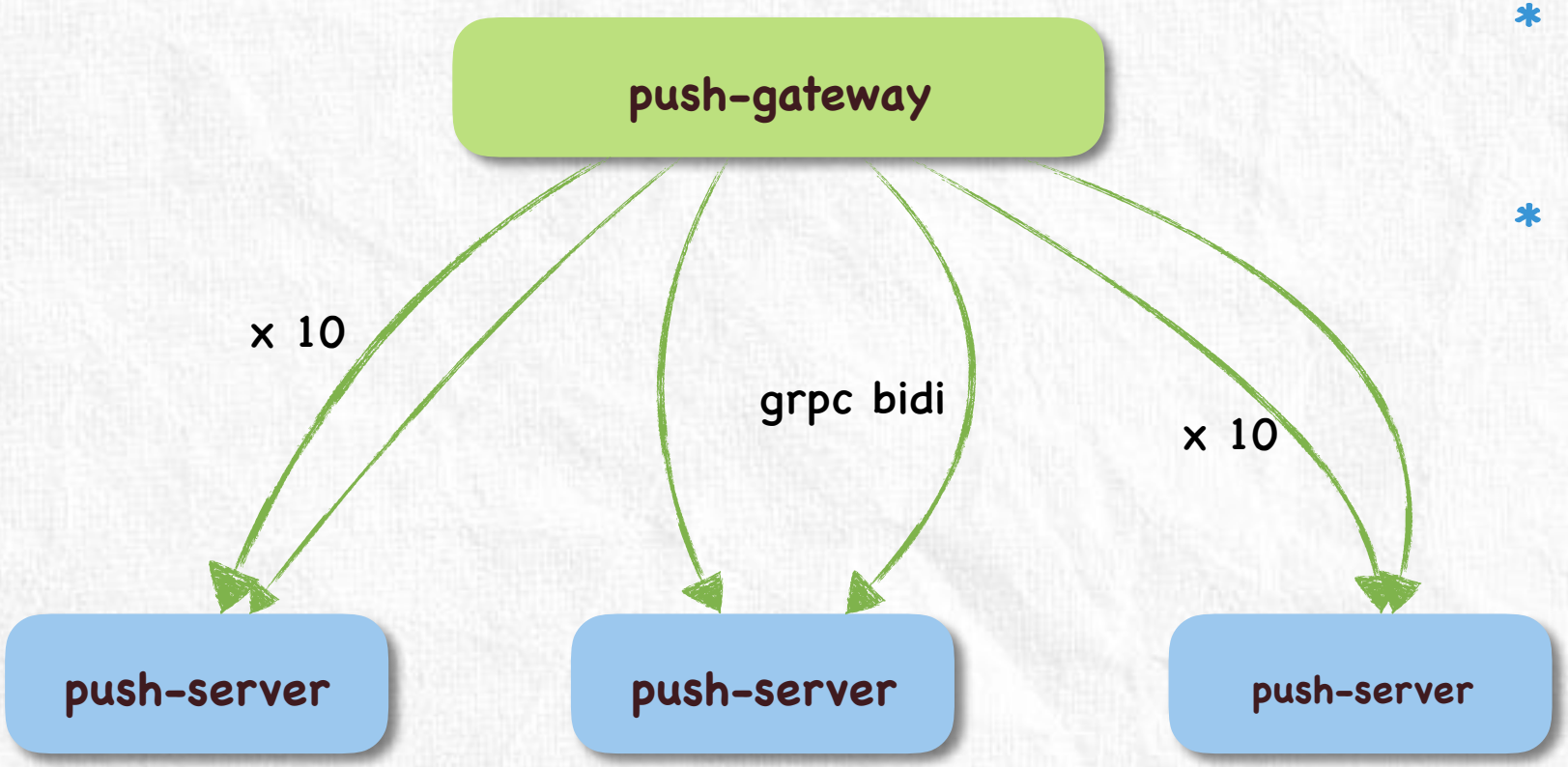
```
// 伪代码
if msg.data == kline {
    mapping.lock()
    clients := mapping.get(msg.tag)
    mapping.unlock()

    for c := range clients {
        c.notify(msg.data)
    }
}

// 优化后
if msg.data == kline {
    mapping.lock()
    clients := mapping.get(msg.tag)
    mapping.unlock()

    clientChunks := splitChunk(clients)

    for chunk := range clientChunks {
        gopool.put(func(){
            notify(chunk)
        })
    }
}
```

推送优化

- kline订阅关系变更
  - 用户的订阅和撤销订阅，以及上下线
  - 发布订阅消息时需遍历订阅客户端
- kline是双层嵌套的map，频繁变更带来锁竞争
- kline map
  - ticker_btc:usdt
    - client1
    - client2
    - ...
  - ticker_btc:eth
    - client1
    - client3

- 嵌套map改成分段为1024个map结构
- 锁粒度尽量降低到topic级别

grpc连接池

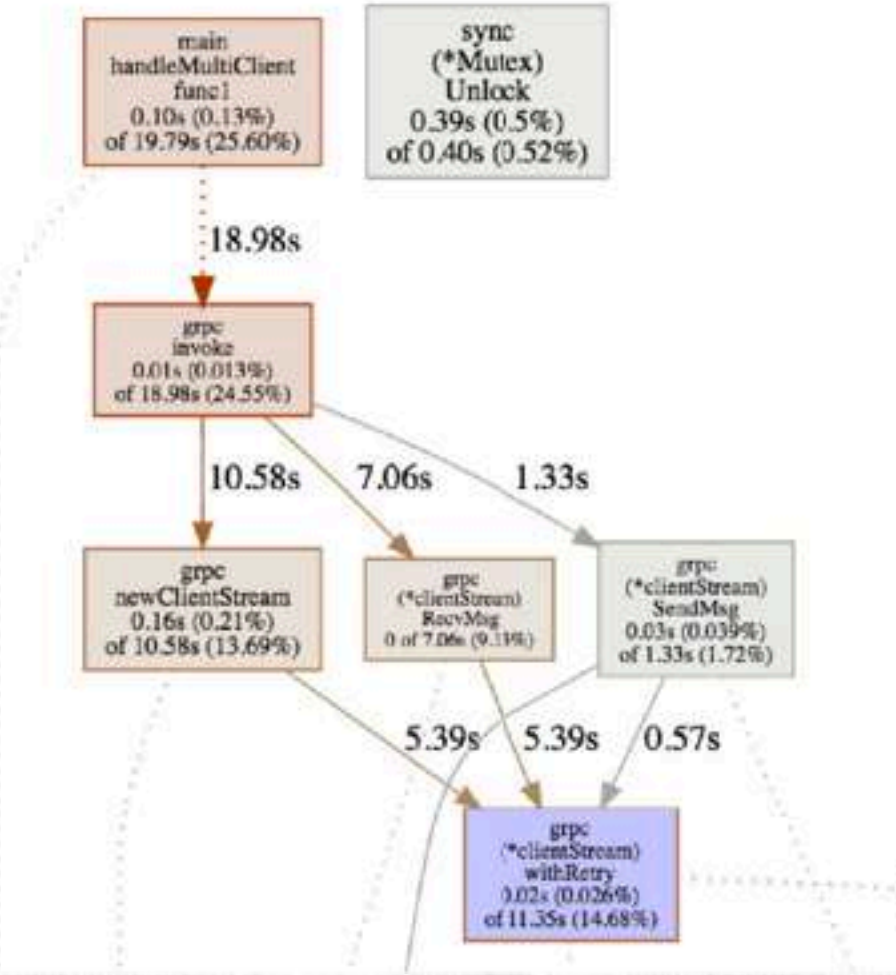


- 为什么要使用连接池?
  - stream复用产生了锁竞争
- benchmark
  - 1 client, 100 goroutine, 8w qps
  - 1 client, 300 goroutine, 5w qps
  - 10 client, 300 goroutine, 15w qps
  - 50 client, 300 goroutine, 30w qps

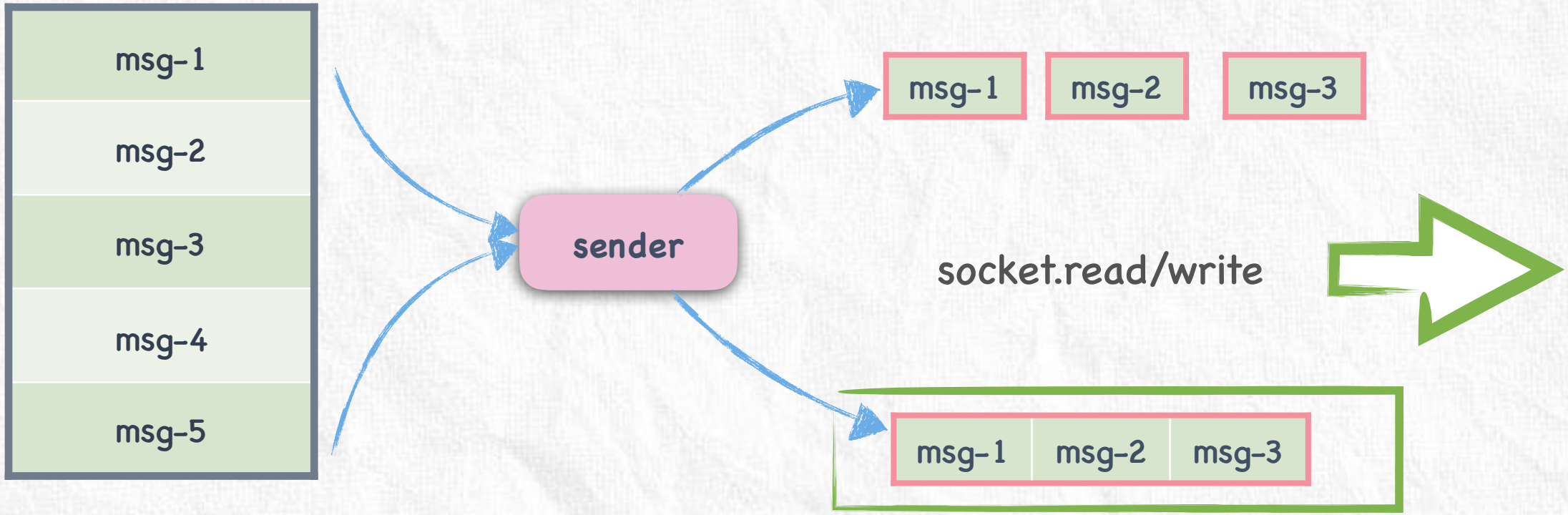
grpc连接池

pprof VIEW SAMPLE REFINE Search regexp

Flat	Flat%	Sum%	Cum	Cum%	Name
10.99s	14.22%	14.22%	11.36s	14.69%	syscall.Syscall
9.06s	11.72%	25.93%	9.06s	11.72%	runtime.futex
6.20s	8.02%	33.95%	6.20s	8.02%	runtime.epollwait
2.12s	2.74%	36.70%	8.06s	10.43%	runtime.lock
1.88s	2.43%	39.13%	4.95s	6.40%	runtime.scanobject



减少系统调用



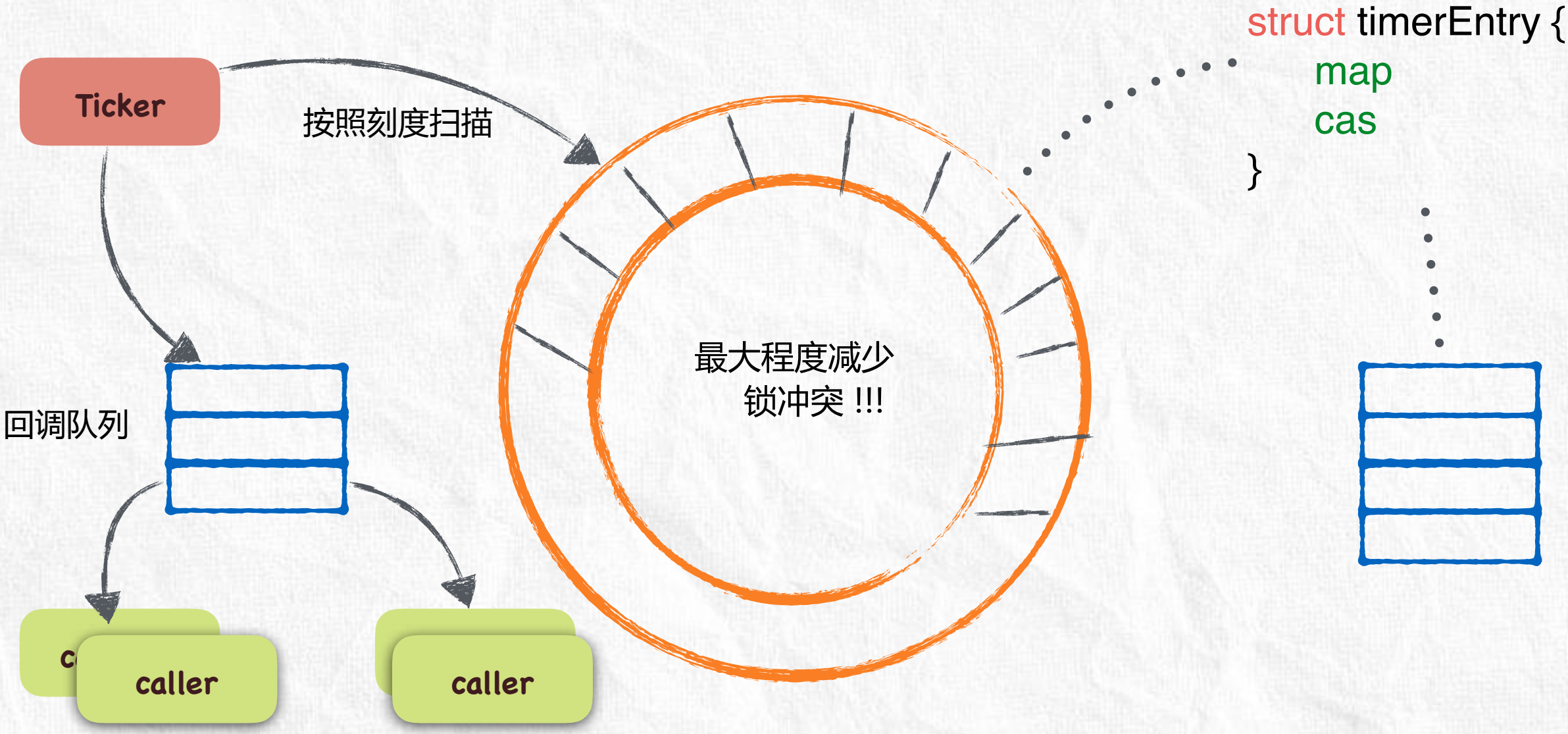
* 减少上下文切换
* 减少cpu sys的使用率

心跳定时器优化

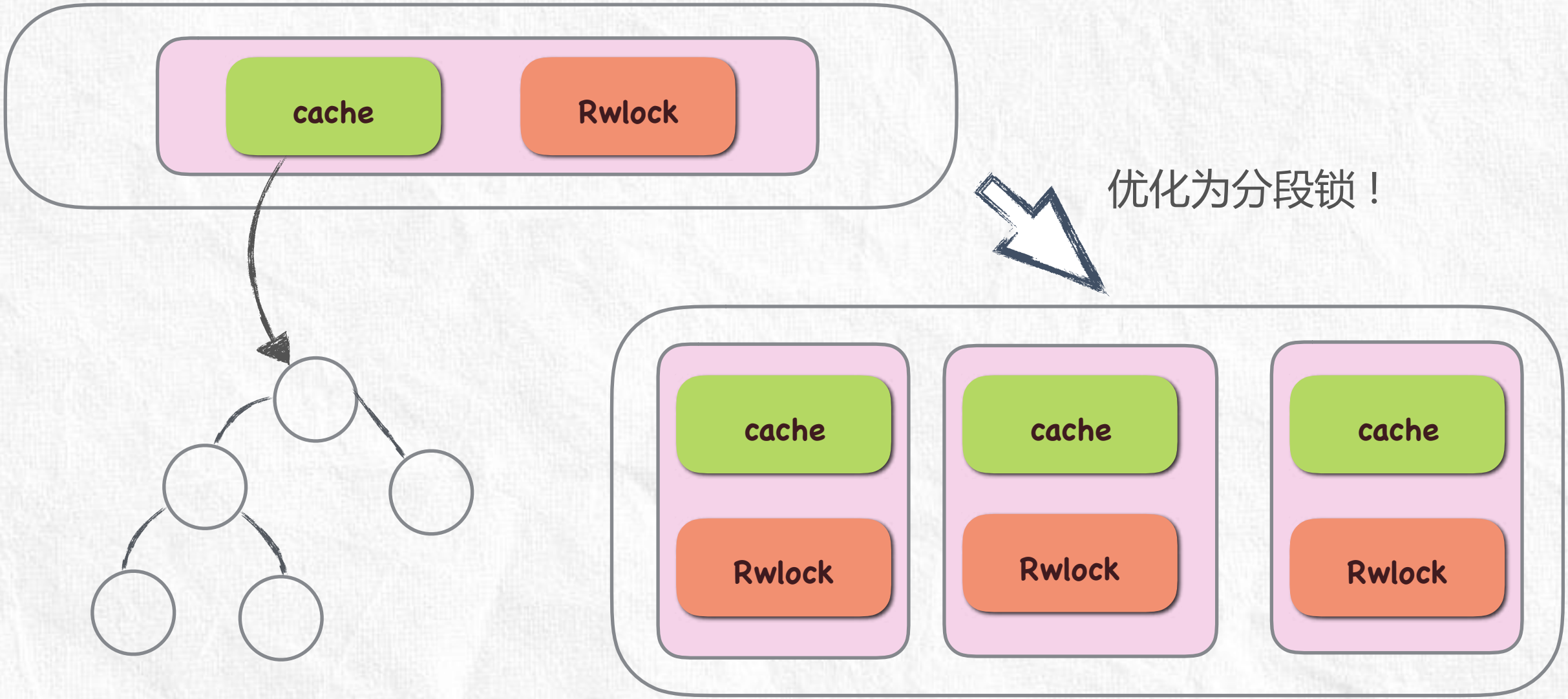
- 升级golang版本到1.10.3以上
  - runtime改进为p个timer定时器
- 实现自定义时间轮
  - 锁分散到每个槽位
  - 使用map存储定时任务
  - 损失精度来减少锁竞争

- 严重的锁竞争
- 业务上允许低时间精度

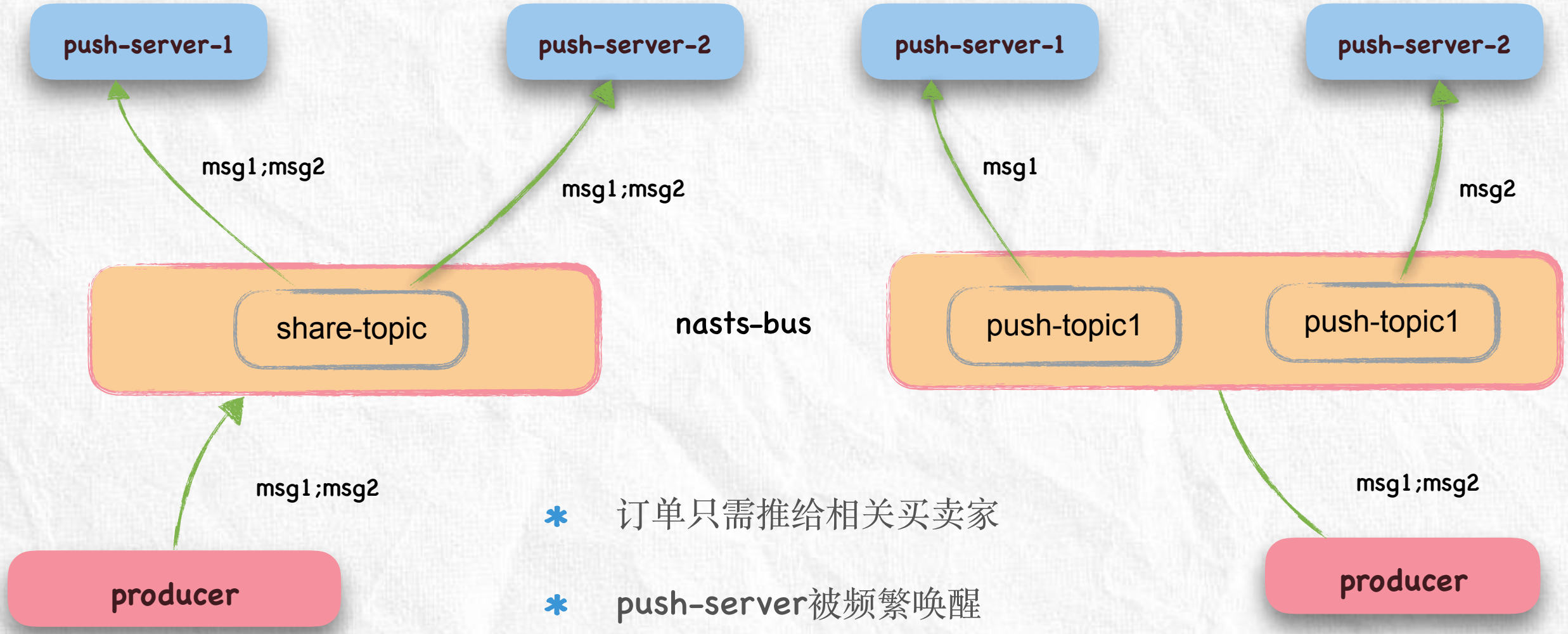
定时器优化


Ticker
按照刻度扫描
回调队列
caller
caller
最大程度减少
锁冲突 !!!
struct timerEntry {
map
cas
}

缓存优化

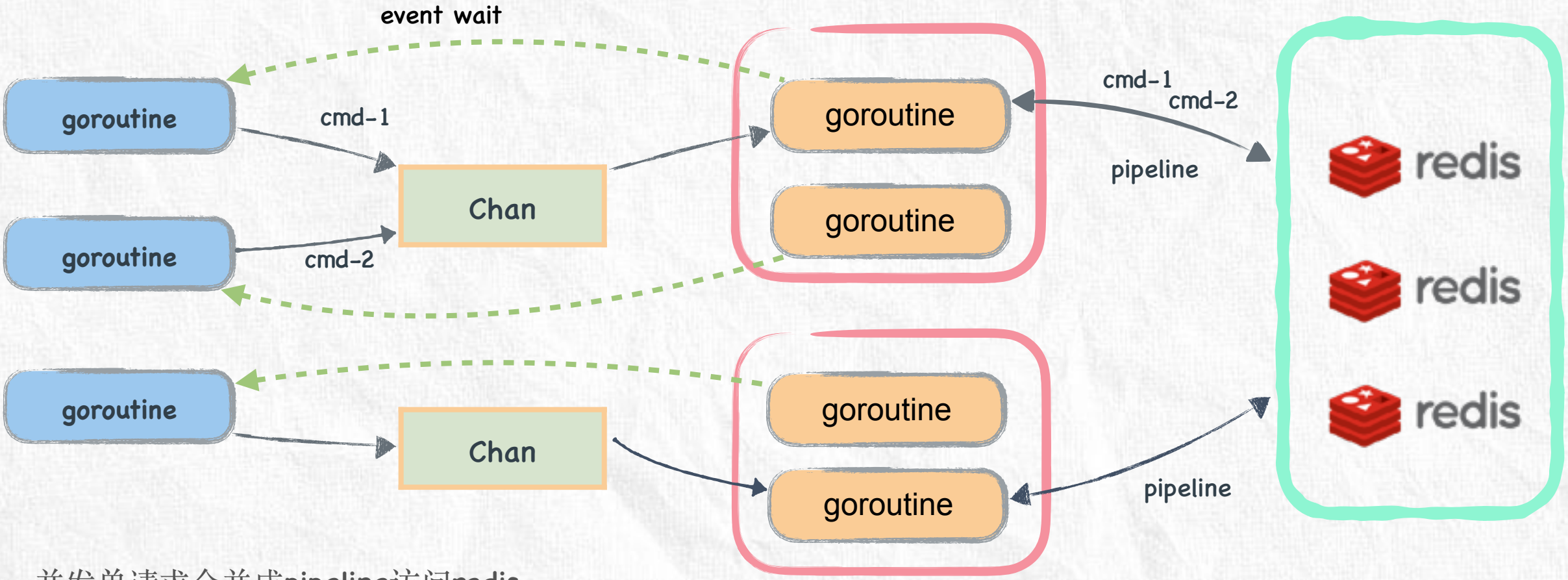

cache
Rwlock
优化为分段锁！
cache
Rwlock
cache
Rwlock
cache
Rwlock

广播惊群



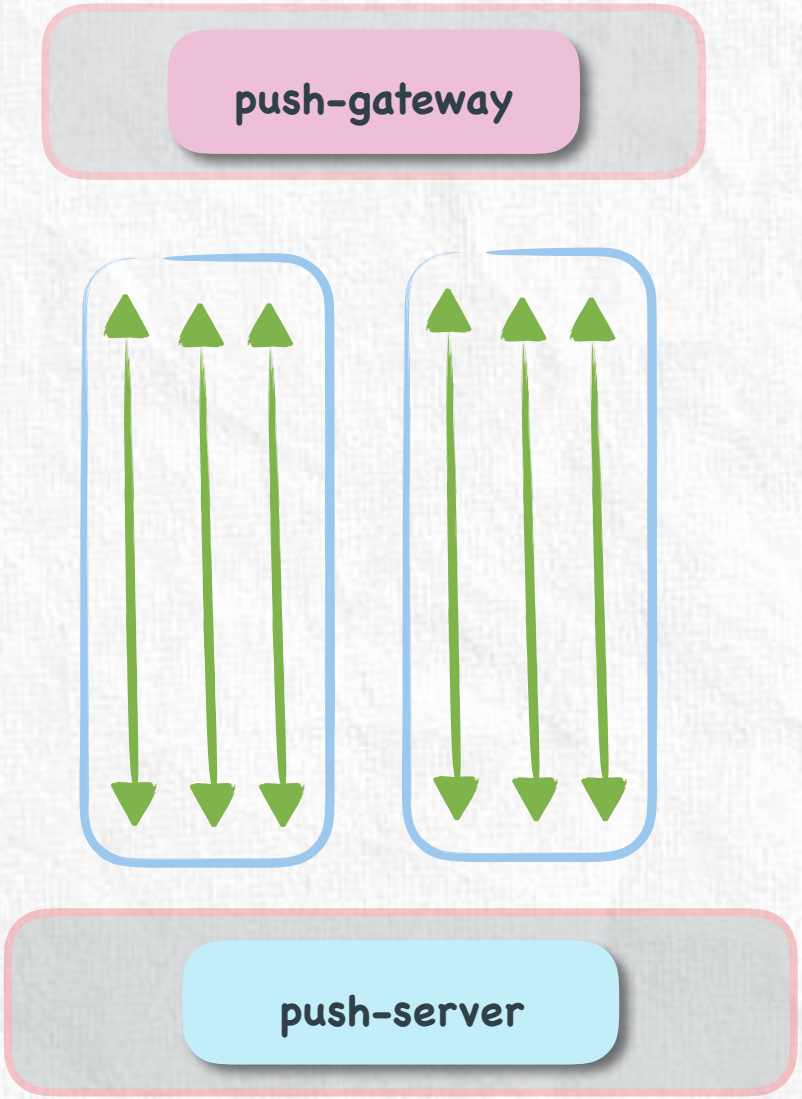
- 订单只需推给相关买卖家
- push-server被频繁唤醒

加大吞吐



* 并发单请求合并成pipeline访问redis
* 减少系统调用开销

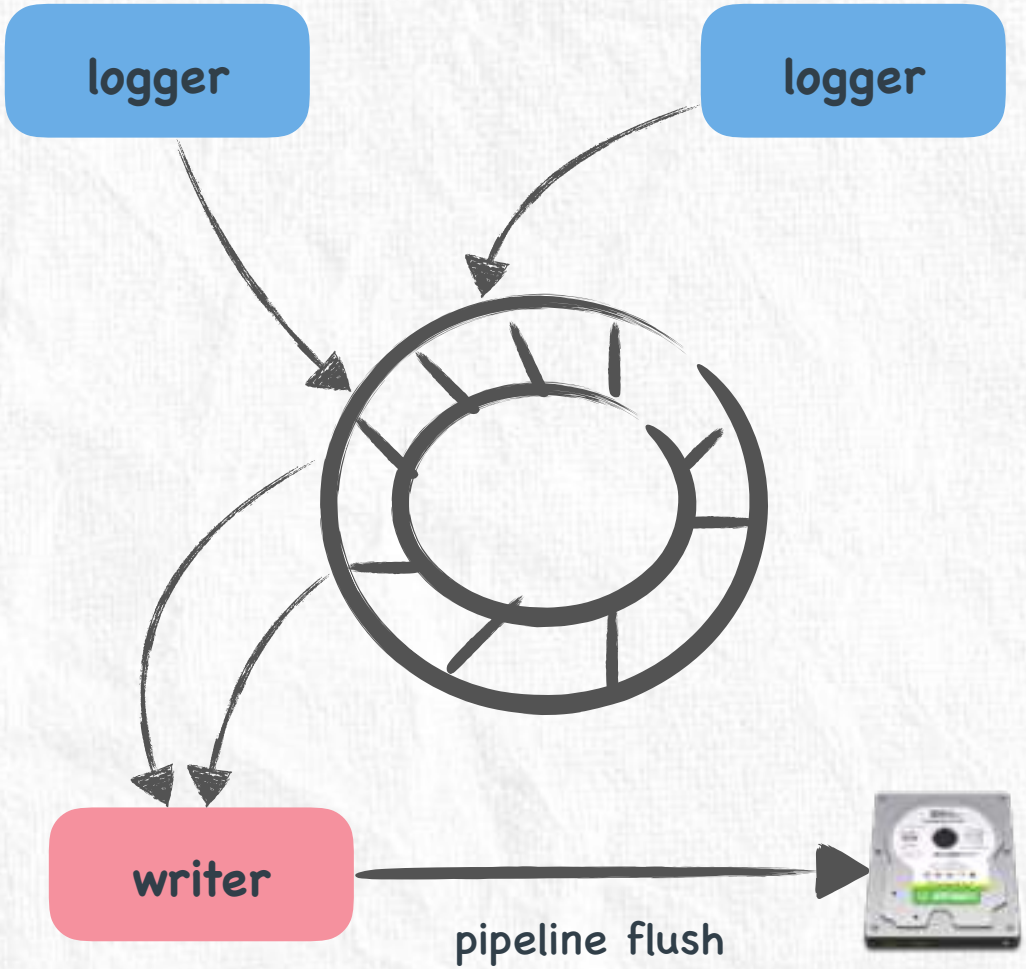
减少协程数



- 每个订阅请求复用已创建好的stream池
- push-gateway -> push-server
  - 初始化 > 10个连接
  - 共初始化100个通用型的stream通道
  - 每个stream为一个go协程

日志引起的问题

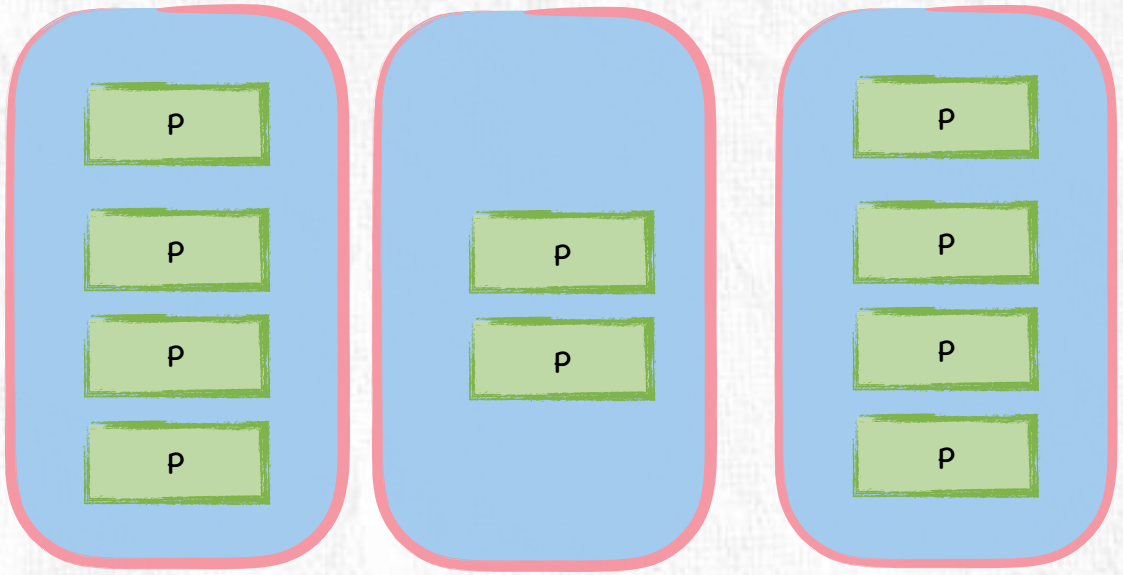
- golang线程数增多
  - 宿主机disk io有时飙高，引起写日志阻塞
  - 继而造成runtime sysmon检测
  - 由于syscall长时间阻塞，启用新线程绑定P
  - 线程数不会减少
- 由于disk io阻塞业务协程，造成时延升高



golang in docker

- golang默认P的数量为取cpu core
- docker内cpuinfo为宿主机配置
- P数的增多会增加runtime消耗
- 根据docker的cpu-quota来动态配置P

http://github.com/uber-go/automaxprocs



cpu 64 core

```
root@a4f33fdd0240:/# cat /proc/cpuinfo| grep "processor"| wc -l
64
```

panic: send on closed channel

- 现状
  - 每个client会有读写协程及chan
- 问题
  - 当用户关闭退出时，如何清理回收？
- 方法
  - 不主动关闭channel
  - 关闭context通知
  - 解绑 topic-> client对应关系及删除

```
type StreamNotifier struct {
    Guid  string

    InQueue chan interface{}
    OutQueue chan interface{}

    closed int32
    ctx    context.Context
    cancel context.CancelFunc
}

func (sc *StreamNotifier) IsClosed() bool {
    if sc.ctx.Err() == nil {
        return false
    }
    return true
}
```

高可用性

- if push-router crash ?
  - 多个router由envoy-ingress负载均衡
- if push-gateway crash?
  - push-router会得知健康状态
  - 客户端从push-router获取可用的gateway
- if push-server crash ?
  - gateway从router选择最优push-server
  - 下发行情订阅请求
  - 通过上次的ack id下发用户订单订阅

内核优化

- 开启bbr拥塞控制算法
  - 国内不明显
  - 外国效果明显
- 软中断优化
  - 多队列网卡
  - 绑定cpu中断

各类优化

- 必须注意锁竞争的问题
- 使用sync.pool缓存频繁的堆对象
- 使用bytes.Buffer解析协议
- 预先设定slice、map的size
- 减少系统调用
- 优化defer的调用

- 通过pipeline提高各端的效率
- 协程池
  - 控制并发
  - 消除毛刺
  - 减少more stack

排坑记

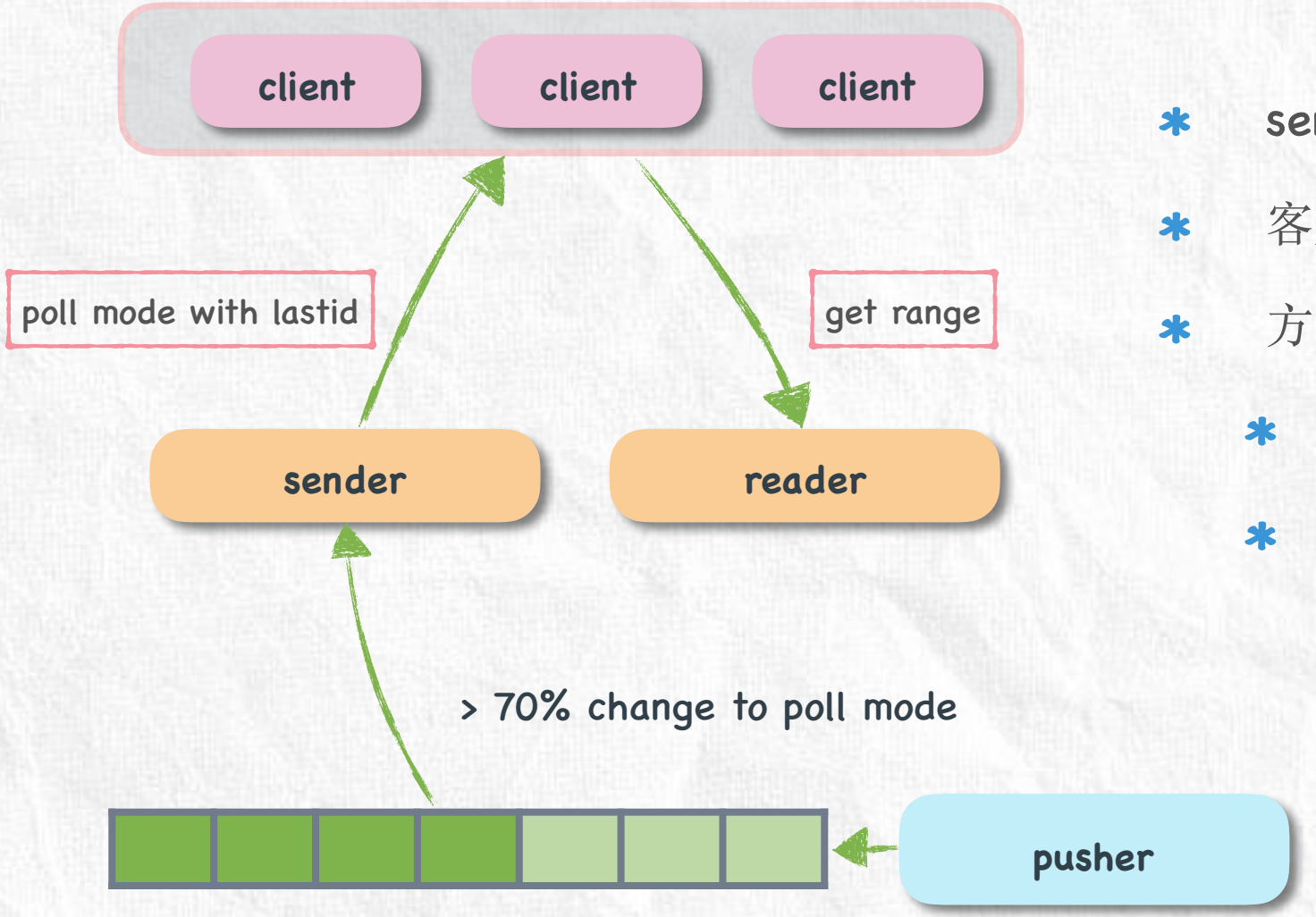
大坑

- grpc-web
  - 不支持bidi mode
  - 需要envoy做协议转换
- goroutine per connnect模式造成协程过多
- kcp的表现并不美好

小坑

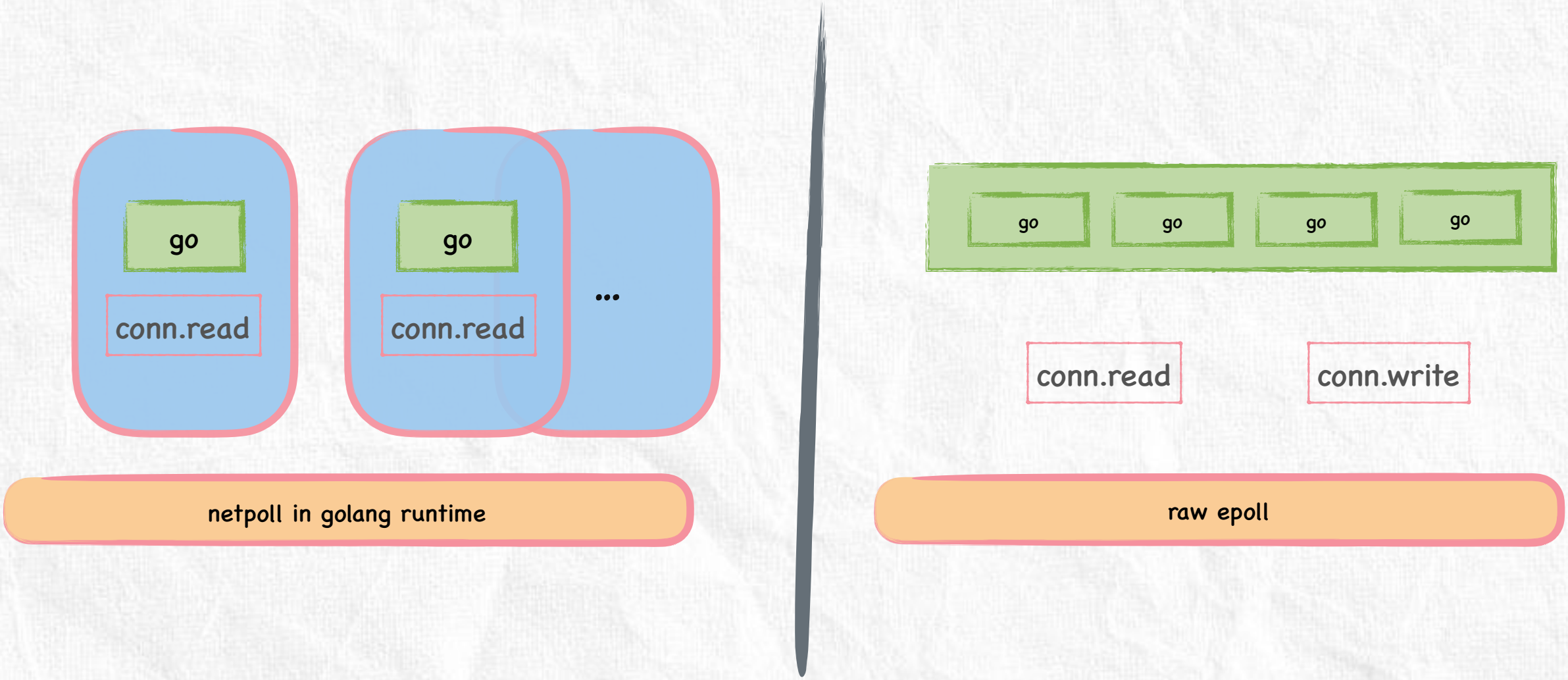
- runtime gFree & allgs
- runtime开销
  - 过多的退出协程
  - 过多的休眠协程
  - gc, sysmon, deadlock check ...

慢客户端问题



* send msg -> chan -> go -> grpc.stream
* 客户端因弱网络导致chan满而阻塞
* 方法
  * 推送模式改为半推半拉模式
  * 重置缓冲，重新开始

netpoll vs raw epoll



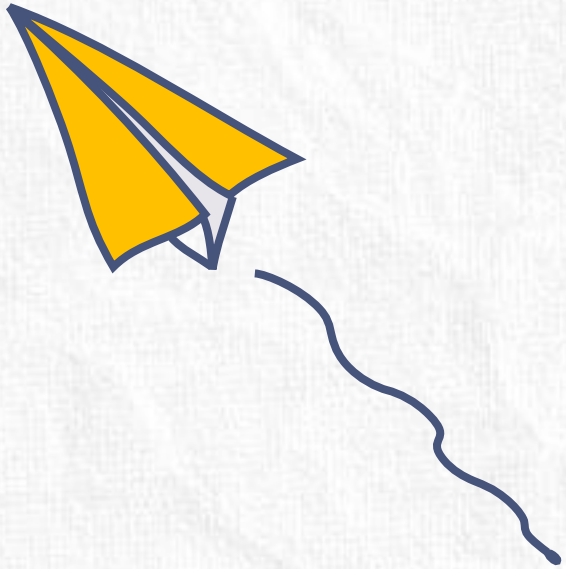
总结

deploy

- 使用drone pipeline持续集成
- 使用k8s为编排引擎
  - 设定节点的亲和非亲和策略
  - 为更好的灵活部署，开发Operator控制器
- 规避网络链路长引起性能及时延问题
  - push-gateway直接使用hostport模式
    - 减少ingress或iptables带来的延迟损耗。
  - push-server的service为headless模式

测试 & 压测

* 分布式压测以保证压力源
* 使用tcpcopy导入并放大线上流量到测服集群
* 使用iptables和tc模拟各类弱网络客户端



Q & A