etcd: status updates

Kubernetes Meetup (Bay Area)
24 August 2016

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Agenda

- What is etcd
- Current status (v3.0.x)
- New features (v3.1+)
- Q/A

What is etcd

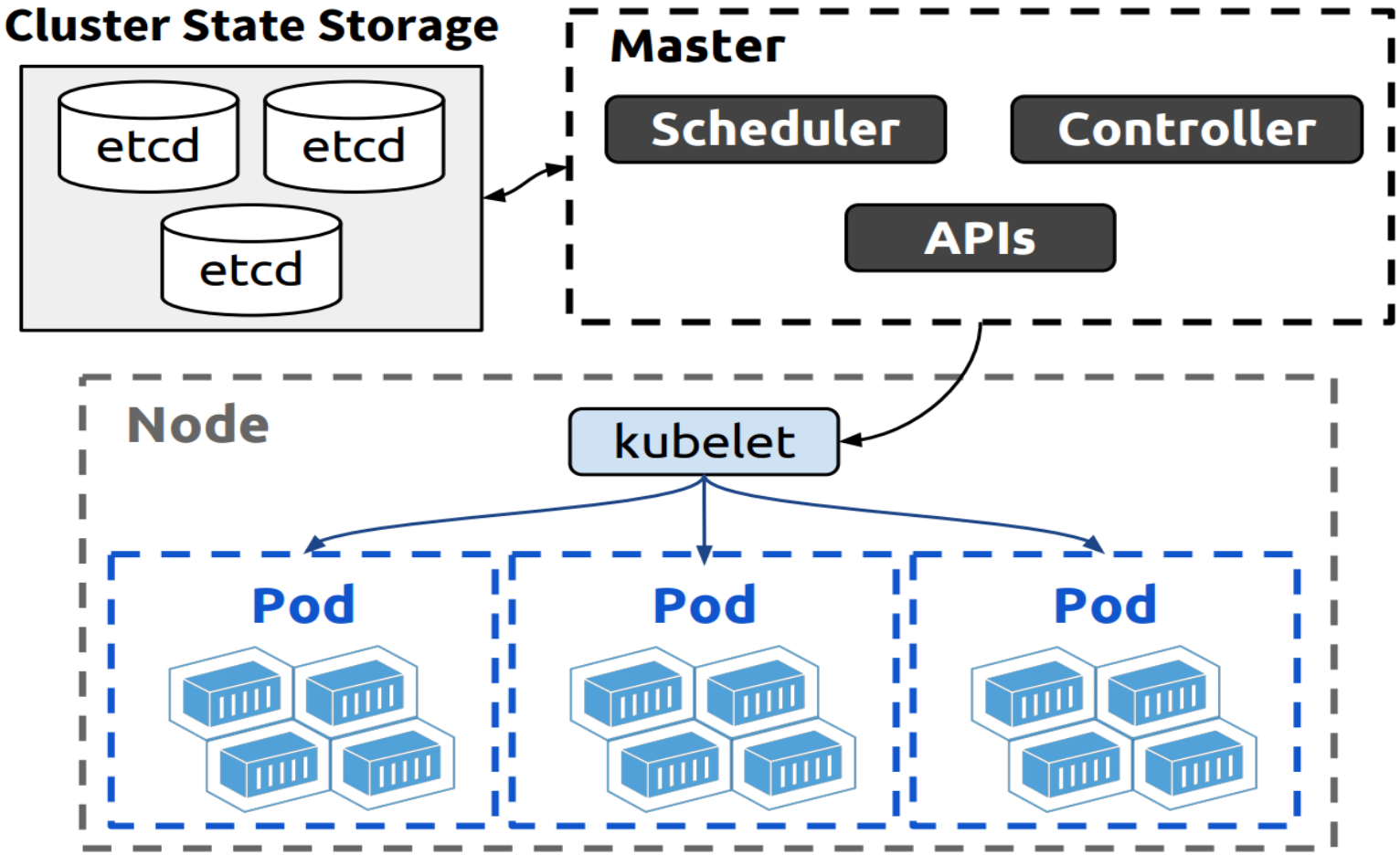
- **Distributed key-value store**
- Open source github.com/coreos/etcd (https://github.com/coreos/etcd) (~ June 2013)
- Still new, compared to ZooKeeper (~ May 2008)

Widely adopted

- Kubernetes, YouTube Doorman (https://github.com/youtube/doorman)
- Red Hat, EMC, Cisco, Huawei, Baidu, Alibaba

etcd + Kubernetes

Consistent + Partition tolerant + (Highly) Available



etcd API

```
cli.Put(ctx, "foo", "bar", Lease)
cli.Get(ctx, "foo")
cli.Delete(ctx, "foo")

// Transaction
kvc.Txn(ctx).
 If(clientv3.Compare(clientv3.Value("key"), ">", "abc")). // txn value comparisons are lexical
 Then(clientv3.OpPut("key", "XYZ")).                      // this runs, since 'xyz' > 'abc'
 Else(clientv3.OpPut("key", "ABC")).
 Commit()

// Watch for updates on key
ch := cli.Watch(ctx, "foo")
for res := range ch {}

// Distributed locks
mu := concurrency.NewMutex(cli, "foo")
mu.Lock()
mu.Unlock()
```

Use etcd to store configuration

For small chunks of data

```
maxReqBytes = 1.5 * 1024 * 1024  // 1.5MB

DefaultQuotaBytes = int64(2 * 1024 * 1024 * 1024) // 2GB
MaxQuotaBytes = int64(8 * 1024 * 1024 * 1024)     // 8GB
```

For JSON, YAML, text data...

Not for gigabytes of ISO image, videos files...

Current status (v3.0.x)

- Released in June 30, 2016
- Latest v3.0.6

Current status (v3.0.x)

(Reasonably) fast

- Write QPS 33K (vs. 3K with v2)
- Linearizable Read QPS 43K
- Serializable Read QPS 93K (vs. 45K with v2)

v3.1 will be even faster

Current status (v3.0.x)

(Super) stable

Extensive testing (unit, integration, end-to-end)

+12,000 failure injections per day

+3.5M injected for etcd v3

- kill members, leader
- network partition
- slow network
- fail points

Upcoming releases

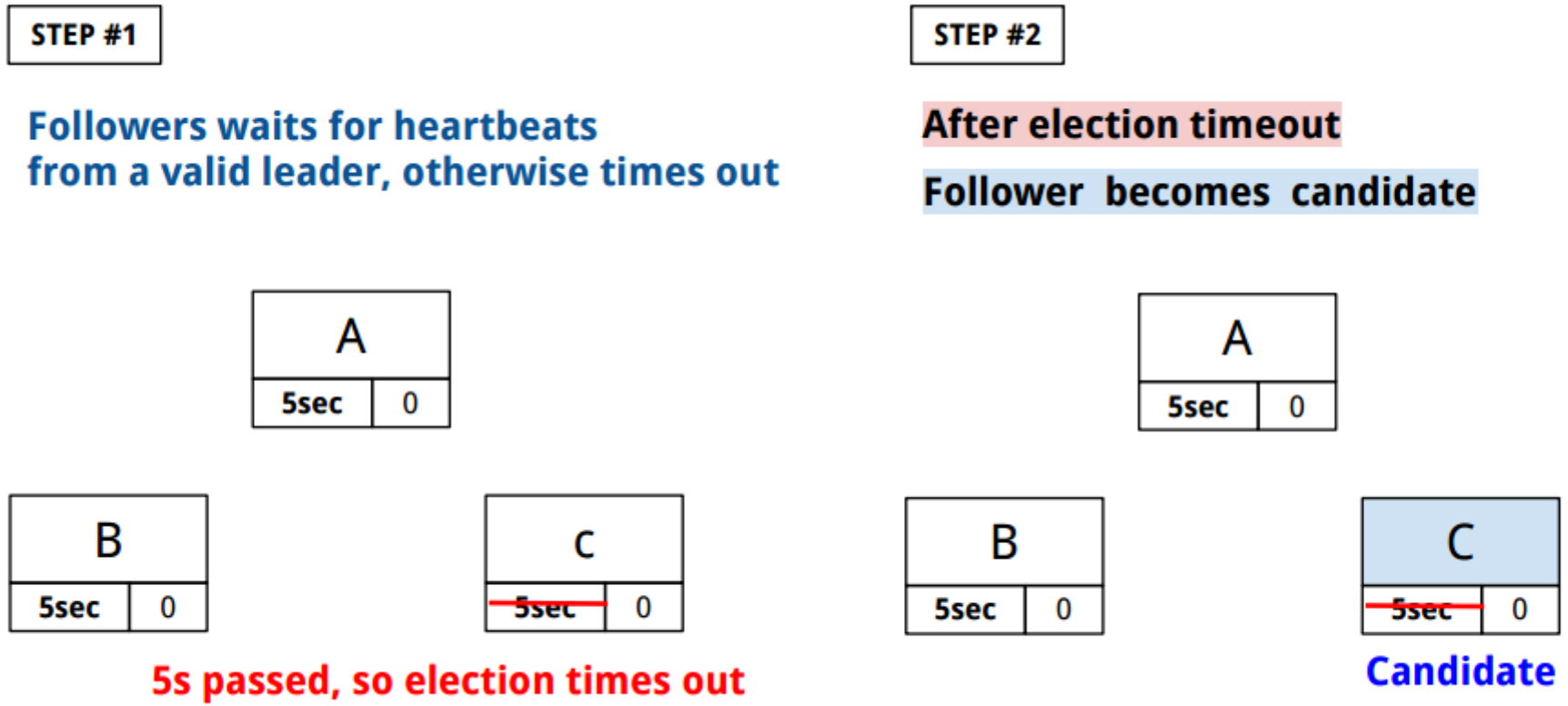
- v3.1-beta in mid-September
- GA in October

What's new in v3.1+?

Raft 101

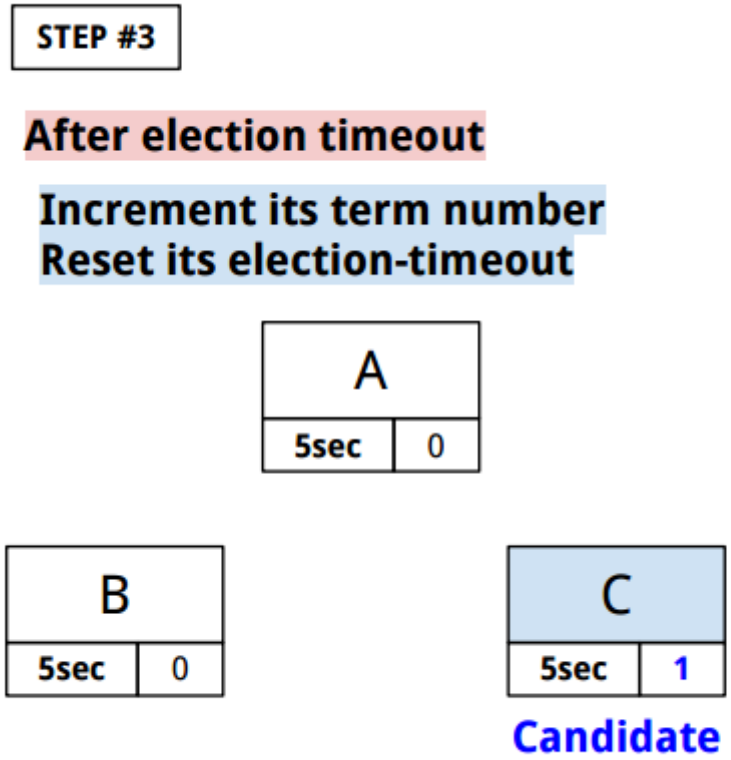
Raft leader election

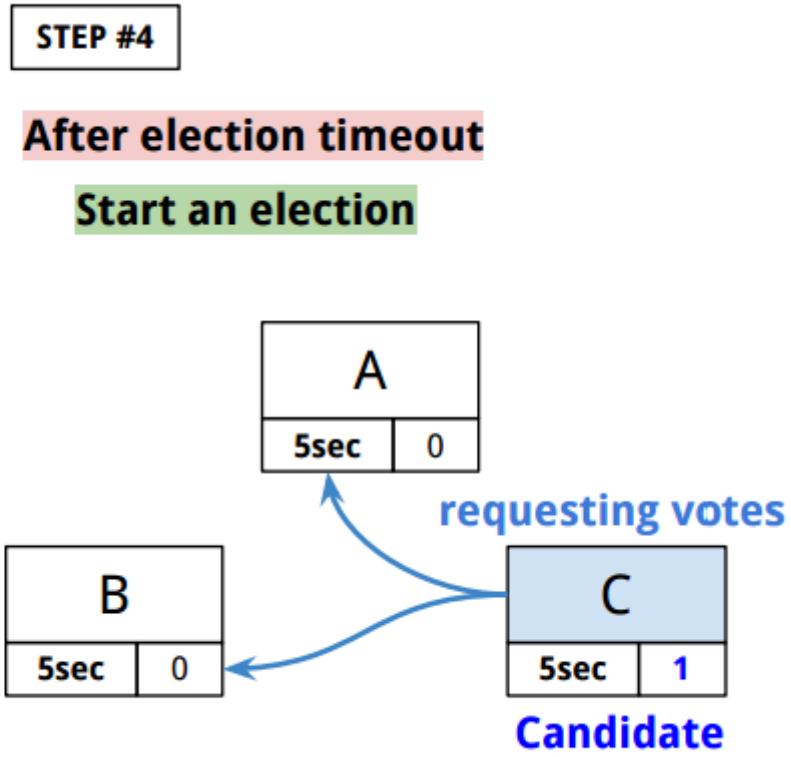
- Follower becomes candidate if there's no leader within election-timeout



Raft leader election

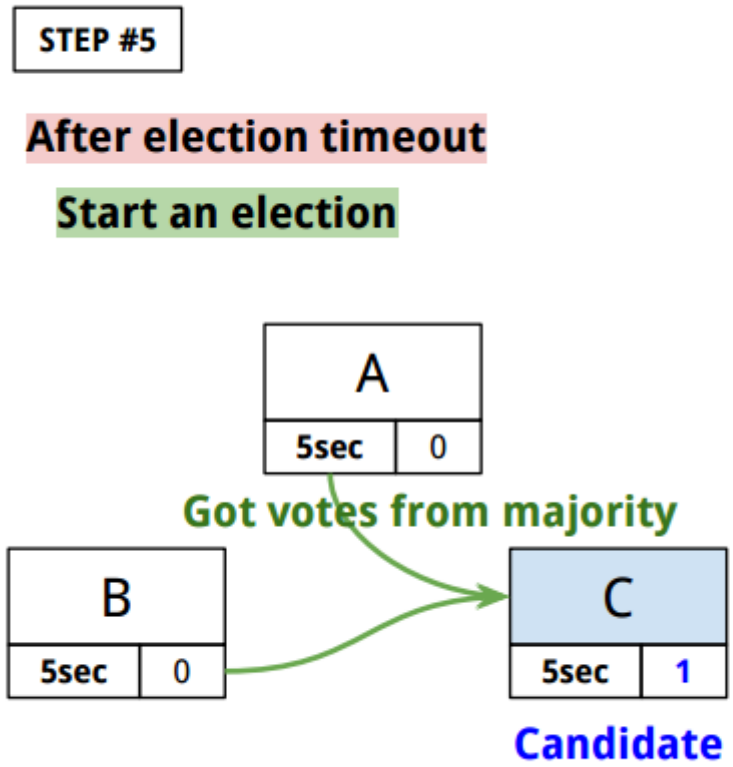
Follower starts election

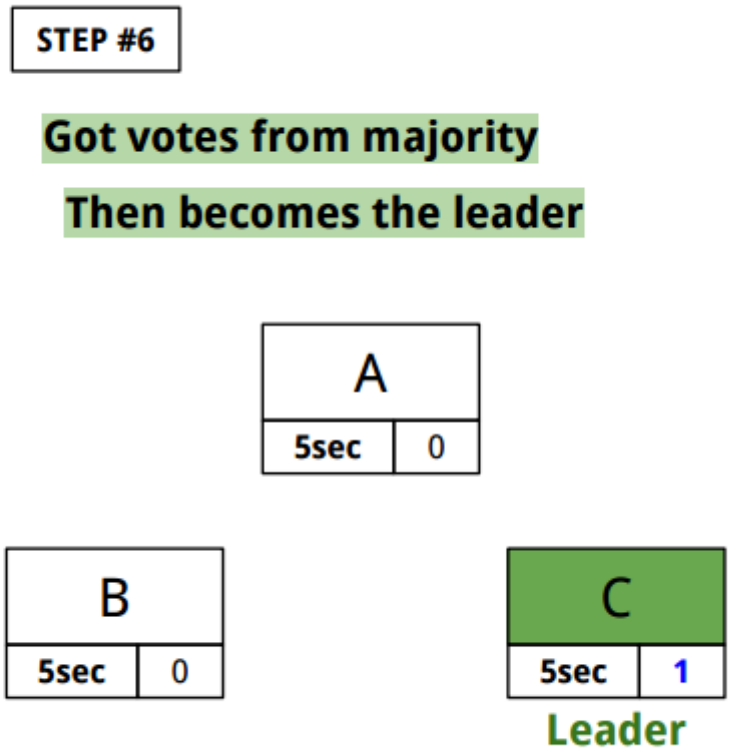




Raft leader election

Got votes from majority, then becomes leader

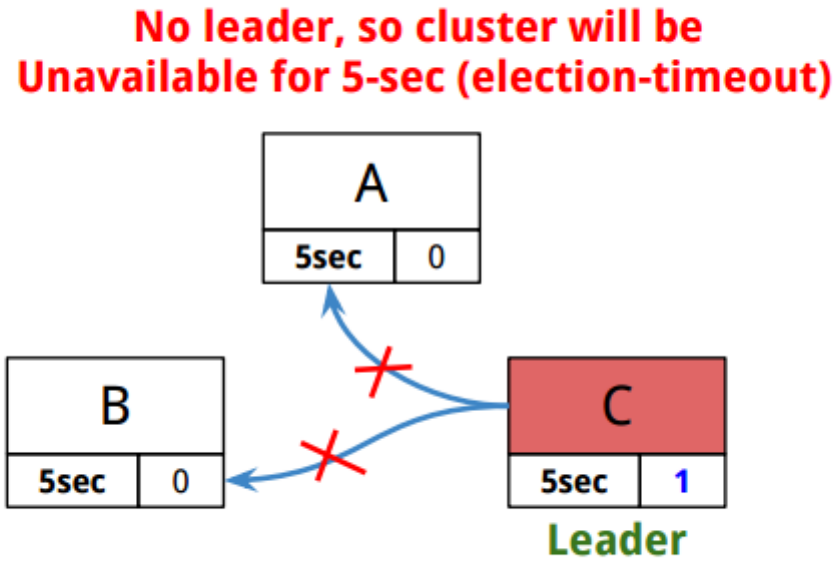




What if leader goes down?

No leader, so cluster becomes **unavailable**

Until another node election-times out, wins an election



What if leader goes down?

Demo: play.etcd.io (http://play.etcd.io)

Leadership transfer

This brief unavailability can be avoided with **leadership transfer**

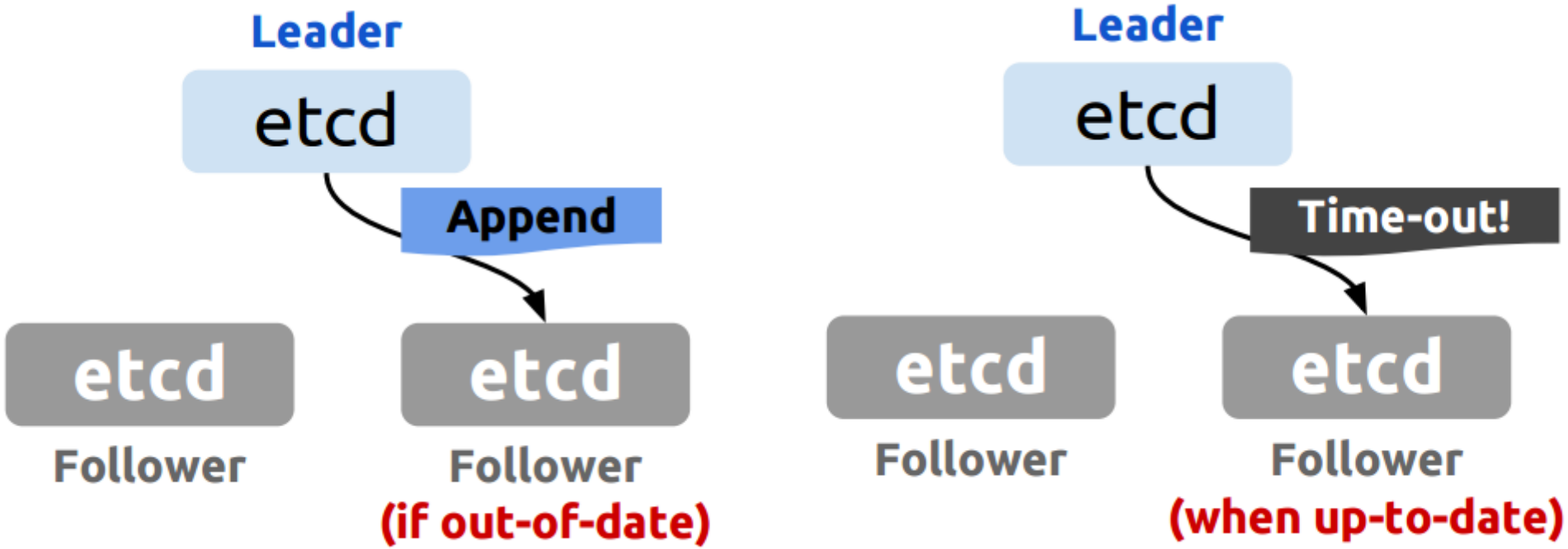
(Raft §3.10 Leadership transfer extension, p.28)

Use case (when leader must step down)

- Rolling upgrade
- Maintenance

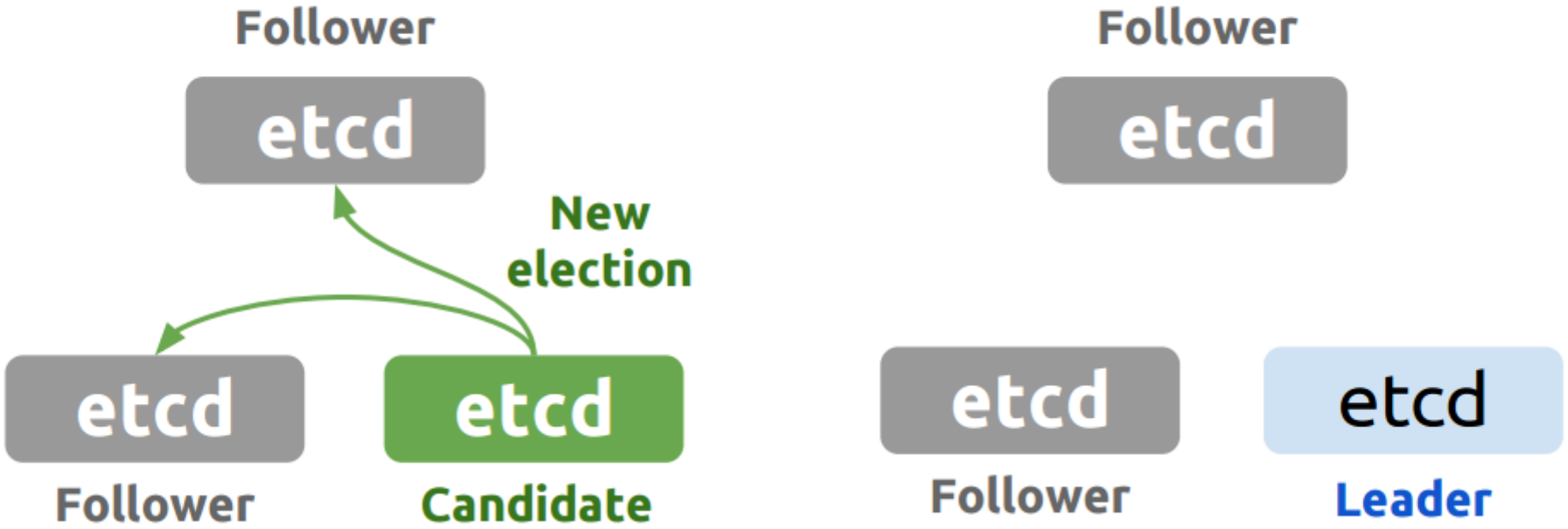
Choose transferee

- Leader sends **MsgAppend** if transferee log is out-of-date
- Then leader sends **MsgTimeoutNow** to transferee
- **Fast-forward** transferee's clock to force **election-time-out**



Leadership transfer

- Now regular Raft leader election
- Transferee(follower) election-times-out, becomes candidate
- And gets elected as leader



Leadership transfer in etcd

etcd leader transfer is automatic (all in server side)

- etcd leader receives **SIGINT**, **SIGTERM**
- etcd leader **chooses one most stable follower as transferee**
- etcd leader **transfers its leadership** BEFORE **shutdown**

Minimum downtime +/-100ms
vs. 1~5s without leadership transfer

Leadership transfer

- Not *"true" zero-time* leadership transfer
- Brief leader-lost while campaigning

We will make it better!

Better performance

etcd v3.0 vs. **v3.1 (Go 1.7)**

- Write QPS 33K vs. **45K (+25% faster)**
- Linearizable Read QPS 43K vs. **55K (+20%)**
- Serializable Read QPS 93K vs. **110K (+15%)**

> Zookeeper v3.4.8 Write QPS *37K*

zetcd

Easiest way to migrate Zookeeper to etcd

- Just change Zookeeper client endpoints to zetcd
- Then zetcd handles Zookeeper requests with etcd
- Provide cross checker for testing, fallback

Working in progress

github.com/chzchzchz/zetcd
(Officially at github.com/coreos/zetcd)

Java client

- Led by community members; WeStudio, PPMoney, Twitter
- github.com/coreos/jetcd (https://github.com/coreos/jetcd)

Faster linearizable read (QGET)

- Linearizable read (QGET) requires quorum(majority) to agree on the value
- Serializable read doesn't go through consensus protocol, served locally

QGET provides stronger consistency, but slower

etcd v3.0 QGET QPS 40K <<< serializable-GET 100K

etcd v3.1 QGET QPS 100K == serializable-GET 100K

Faster linearizable read (QGET)

it is possible to bypass the Raft log for read-only queries and still preserve linearizability

(Raft §6.4 Processing read-only queries more efficiently, p.72)

- Leader records **current commit index** in **readIndex**
- Leader sends **readIndex** to followers
- For followers, **readIndex** is the largest commit index ever seen by any server
- Read-request within **readIndex** is now served locally with linearizability
- More efficient, avoids synchronous disk writes

Proxy

proxies allow a significant increase in the number of clients

A proxy cache can reduce read traffic by at most the mean amount of read-sharing

(Google Chubby paper §3.1 Proxies, p.10)

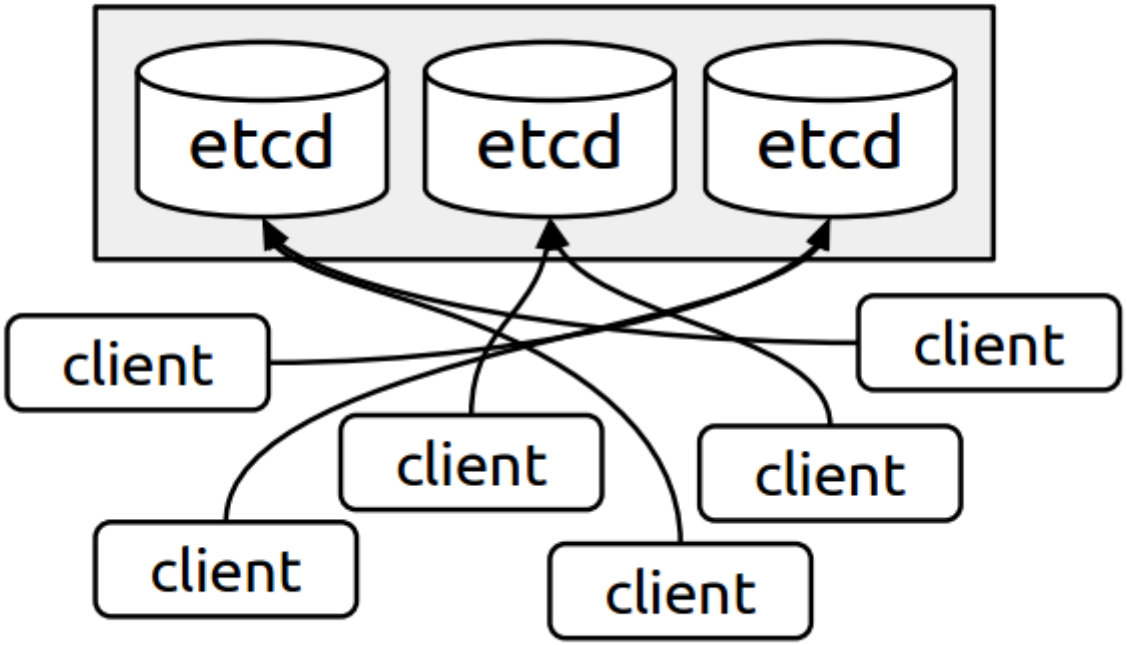
But etcd does not have much proxy use cases yet!

- etcd proxy is still in design process
- need more feedback, use case study

Proxy

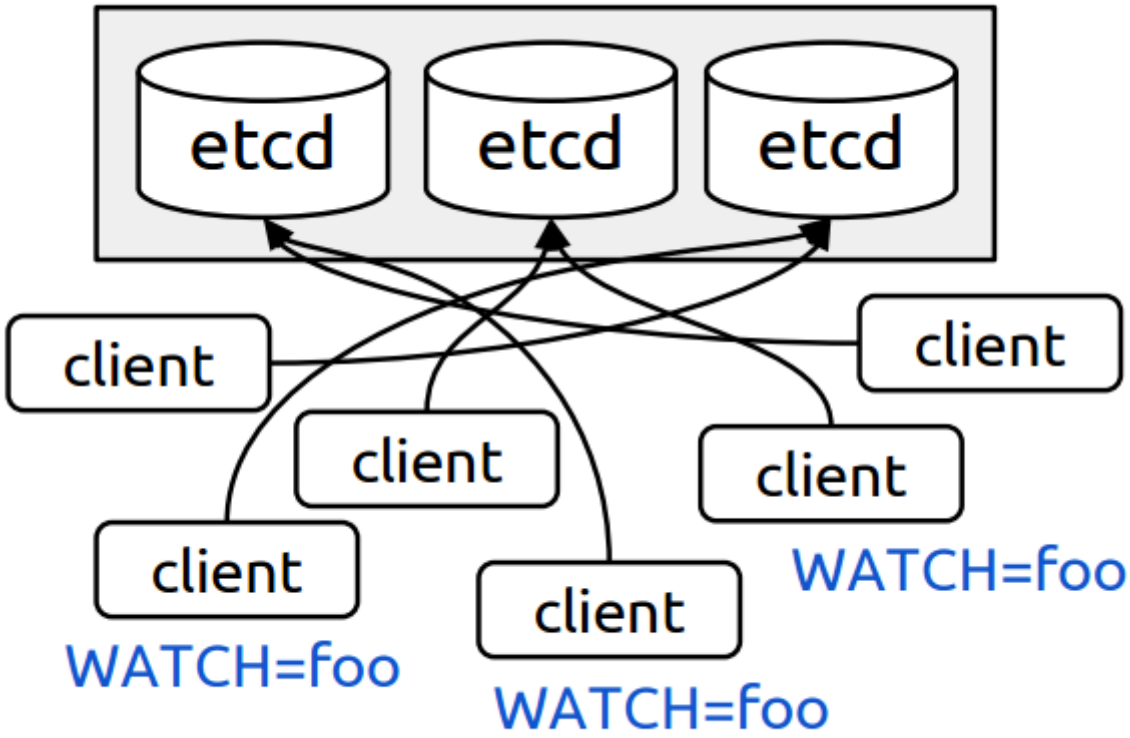
- etcd v2 proxy is just HTTP proxy (reverse proxy)
- etcd v2 proxy doesn't understand gRPC

etcd v3 clients still talk directly to etcd cluster



Proxy use case

same WATCH requests



Proxy use case

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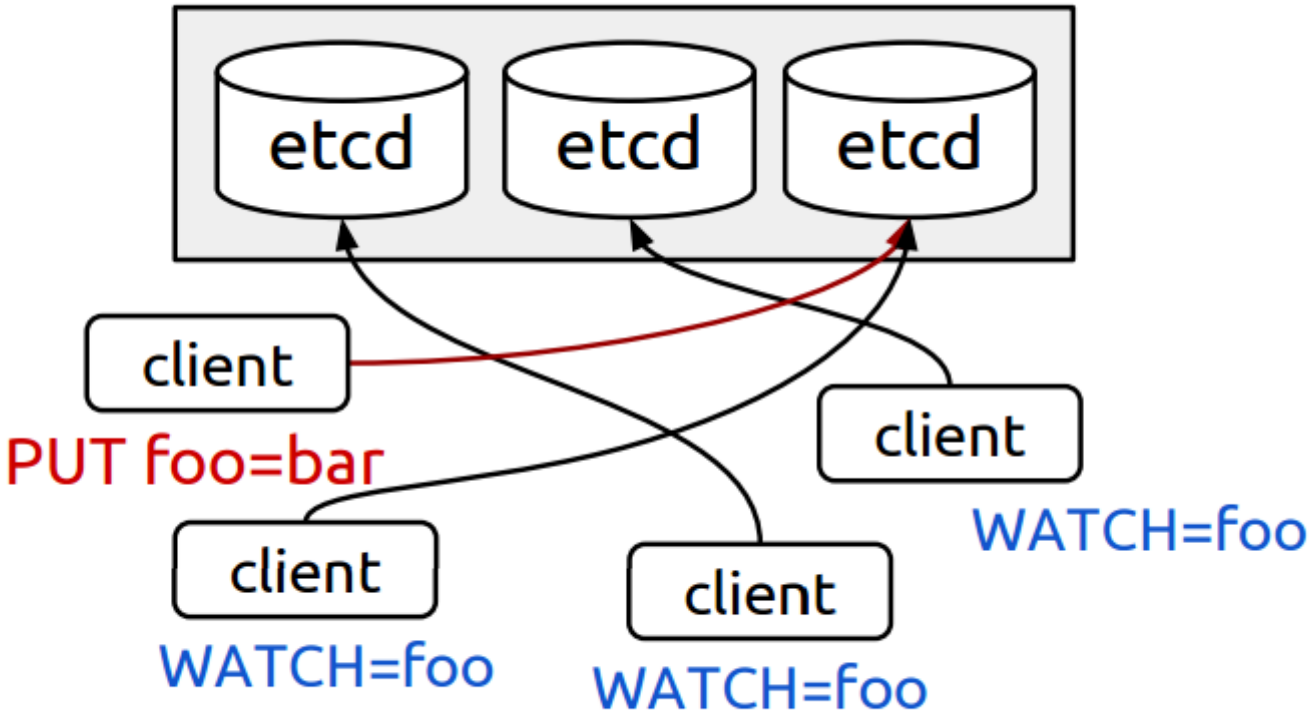
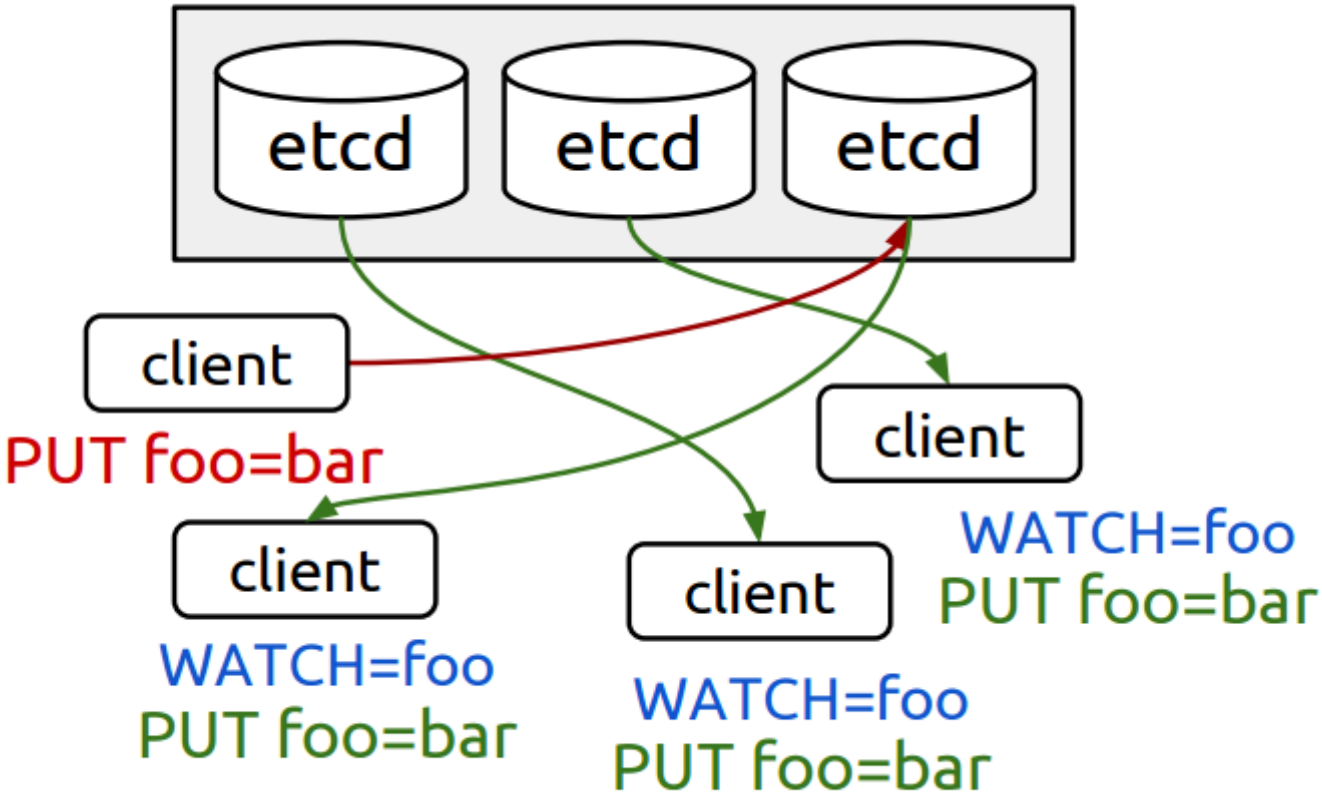


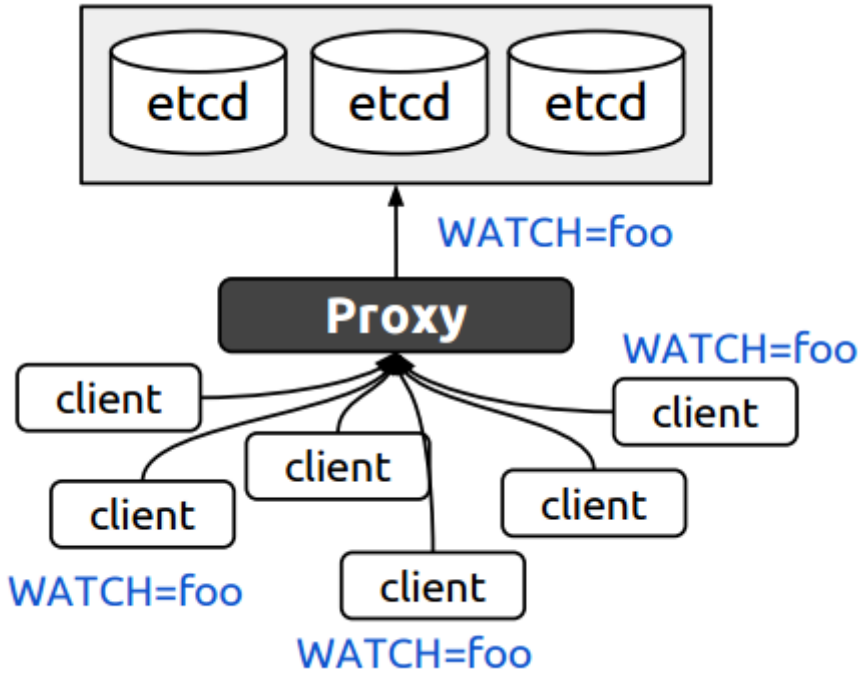
Proxy use case

3 different events are triggered for the same request **(This is inefficient!)**



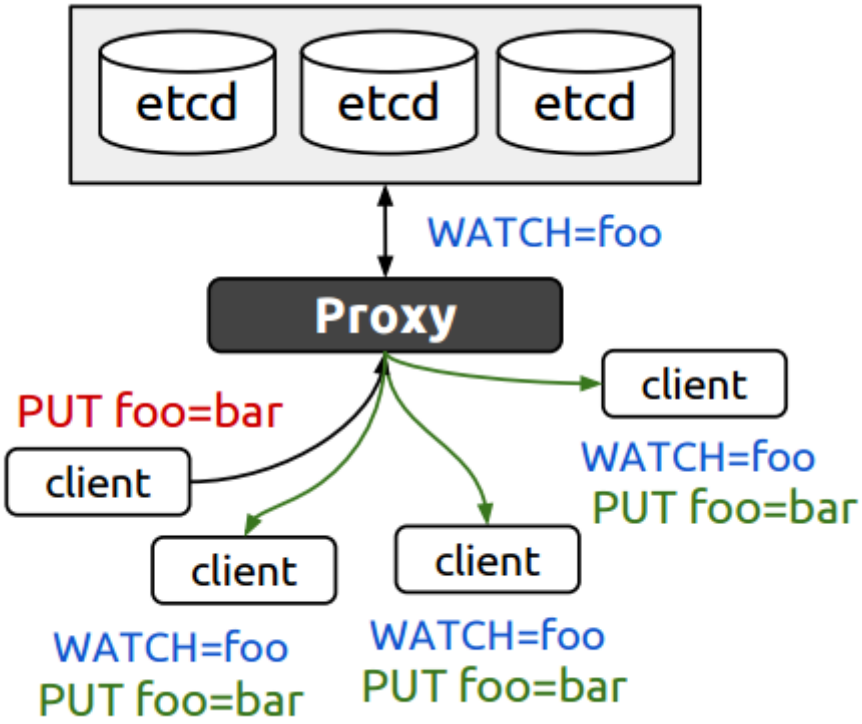
Proxy use case

etcd v3 proxy solves this problem by **coalescing same requests**



Proxy use case

Merged WATCH request



Proxy does all the hard work!

gateway

kube-proxy-like etcd gateway

```
etcd gateway start --endpoints=infra.example.com --listen-addr=127.0.0.1:23790
etcdctl put foo bar --endpoints=127.0.0.1:23790
```

Static endpoint for client requests

```
# even after re-configure infra.example.com
# clients still connects via same endpoint
etcdctl put foo bar --endpoints=127.0.0.1:23790
```

Not built for performance improvement

Embedded etcd server

```
import "github.com/coreos/etcd/embed"

cfg := embed.NewConfig()
cfg.Dir = "default.etcd"

e, err := embed.StartEtcd(cfg)

<-e.Err()
e.Close()
```

etcd clients still connects via gRPC

Embedded client (https://github.com/coreos/etcd/issues/4709) planned for v3.2

Thank you

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https://github.com/coreos/etcd (https://github.com/coreos/etcd)