# 聊聊Raft协议

## 1. 参考资料

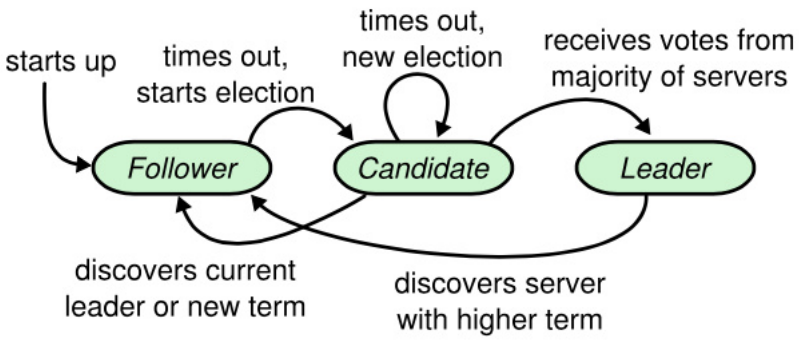
- 1.1 In Search of an Understandable Consensus Algorithm
- 1.2 寻找一种易于理解的一致性算法
- 1.3 Raft协议精解
- 1.4 Raft协议动画演示
- 1.5 goraft/raftd

> The original project authors have created new raft implementations now used in etcd and InfluxDB.

`goraft` 的作者参与了 `etcd` 项目的实现，所以 `goraft` 是有参考价值的。

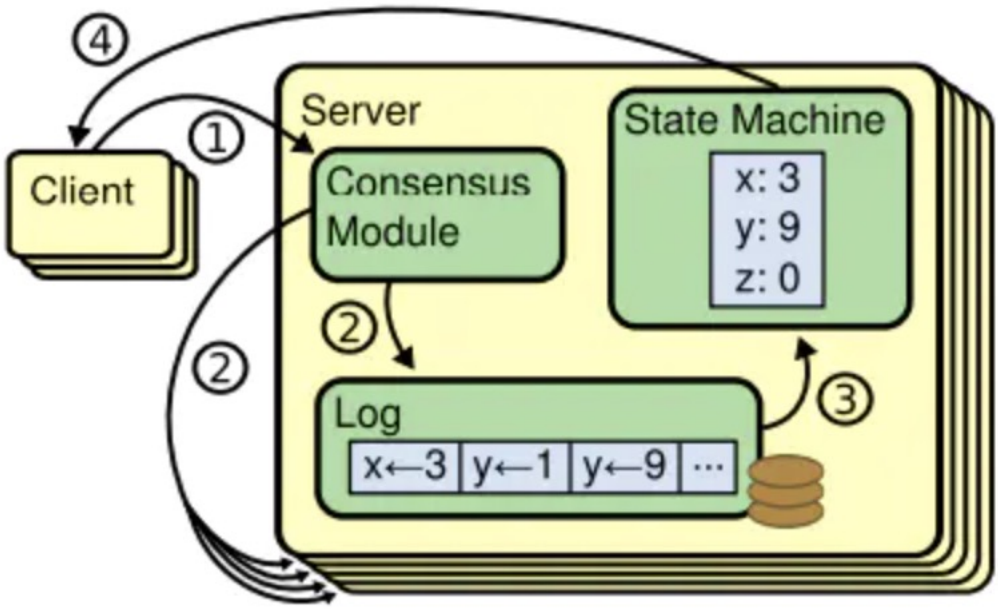
## 2. Node的简单介绍

### 2.1 node的三种状态(state)




- Leader
- Candidate
- Follower

### 2.2 3种不同的存储




#### 2.2.1 Write-Ahead Log（WAL）

存储:文件

```
        4f
    raft:join">{"name":"2832bfa","connectionString":"http://localhost:4001"}
```

```
        e
raft:nop      4f
    raft:join">{"name":"3320b68","connectionString":"http://localhost:4002"}
      4f
    raft:join">{"name":"7bd5bdc","connectionString":"http://localhost:4003"}
        e
raft:nop      29
write"{"key":"foo","value":"bar"}
      29
write"{"key":"aaa","value":"bbb"}
      29
write"{"key":"bbb","value":"ccc"}
      29
    write"{"key":"ddd","value":"eee"}
       e

raft:nop       e

       raft:nop      29

    write"{"key":"foo","value":"bar"}
      29
    write"{"key":"foo","value":"bar"}
```

#### 2.2.2 状态信息(状态信息)

commitIndex、peer等

存储:内存&文件

```
type server struct {
    *eventDispatcher

    name        string
    path        string
    // Leader、Follower 或者 Candidate
    state       string
    transporter Transporter
    context     interface{}
    // 代表它所感知的全局的Term情况
    currentTerm uint64

    votedFor   string
    log        *Log
    // 代表它所感知的全局的leader情况
    leader     string
    peers      map[string]*Peer
}
```

```
type Log struct {
    ApplyFunc   func(*LogEntry, Command) (interface{}, error)
    file        *os.File
    path        string
    entries     []*LogEntry
    commitIndex uint64
    mutex       sync.RWMutex
    startIndex  uint64 // the index before the first entry in the Log entries
    startTerm   uint64
    initialized bool
}
```

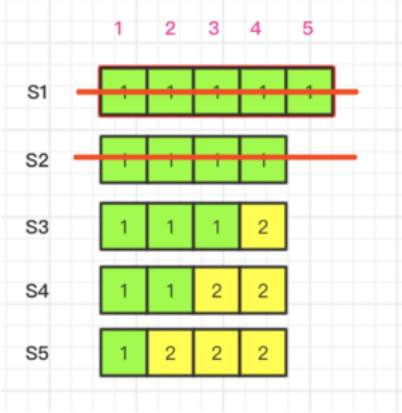
goraft 的实现是写完Log.entries, 接着就写WAL

#### 2.2.3 内存数据库

存储:内存

```
// The key-value database.
type DB struct {
    data  map[string]string
    mutex sync.RWMutex
}
```

### 2.3 节点之间的通讯&重要的名词解释




Leader --> Follower

```
{
    "Term": 17,
    "PrevLogIndex": 26,
    "PrevLogTerm": 17,
    "CommitIndex": 26,
    "LeaderName": "2832bfa",
    "Entries": [{
        "Index": 27,
        "Term": 17,
        "CommandName": "write",
        "Command": "eyJrZXkiOiJhYWEiLCJ2YWx1ZSI6ImJiYiJ9Cg=="
    }]
}
```

**名词解释**

- Term
- CommitIndex
- LogEntry

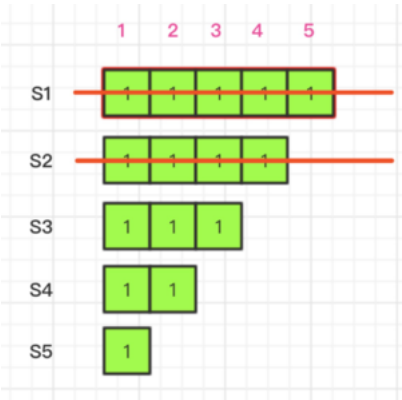
### 3. Leader Election(选举过程)

**注意**:不需要集群中节点的数量是奇数 可以是4、8个，都没关系

#### 3.1 什么时候开始选举?

#### 3.2 投票相关--如何处理VoteRequest

看参考资料1.4 的演示动画




##### 3.2.1 一个Term期间，最多只能投出1票

```
// VoteRequest中的Term，必须大于本地的currentTerm
    if req.Term < s.Term() {
        s.debugln("server.rv.deny.vote: cause stale term")
        return newRequestVoteResponse(s.currentTerm, false), false
    }

    // If the term of the request peer is larger than this node, update the term
    // If the term is equal and we've already voted for a different candidate then
    // don't vote for this candidate.
// VoteRequest中的Term，如果大于本地的currentTerm，则更新本地的currentTerm
    if req.Term > s.Term() {
        s.updateCurrentTerm(req.Term, "")
    } else if s.votedFor != "" && s.votedFor != req.CandidateName {
```

```
        s.debugln("server.deny.vote: cause duplicate vote: ", req.CandidateName,
            " already vote for ", s.votedFor)
        return newRequestVoteResponse(s.currentTerm, false), false
    }
```

#### 3.2.2 获得投票需要满足的条件

raft协议中这样的要求

> candidate's log is at least as up-to-date as receiver's log then vote

解释起来，就是必须同时满足以下2个条件，才会给candidate投票

- candidate.LastLogTerm >= receiver.LastLogTerm
- candidate.LastLogIndex >= receiver.LastLogIndex

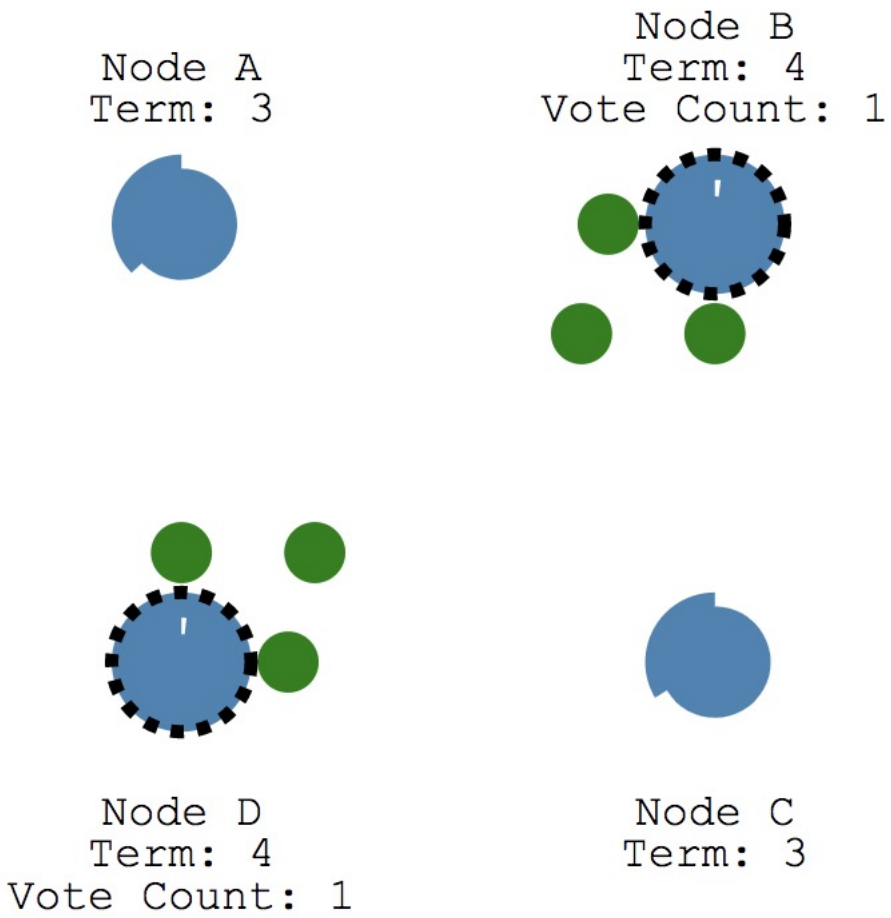
**注意**: Log中有擦除情况出现，所以条件1是必须的

### 3.3 当选&当选后的一系列动作

- 获得 `majority` 投票的候选人当选为 `Leader`
- 通过心跳压制其它 `Candidate`
- 写入 `NOPCommand`

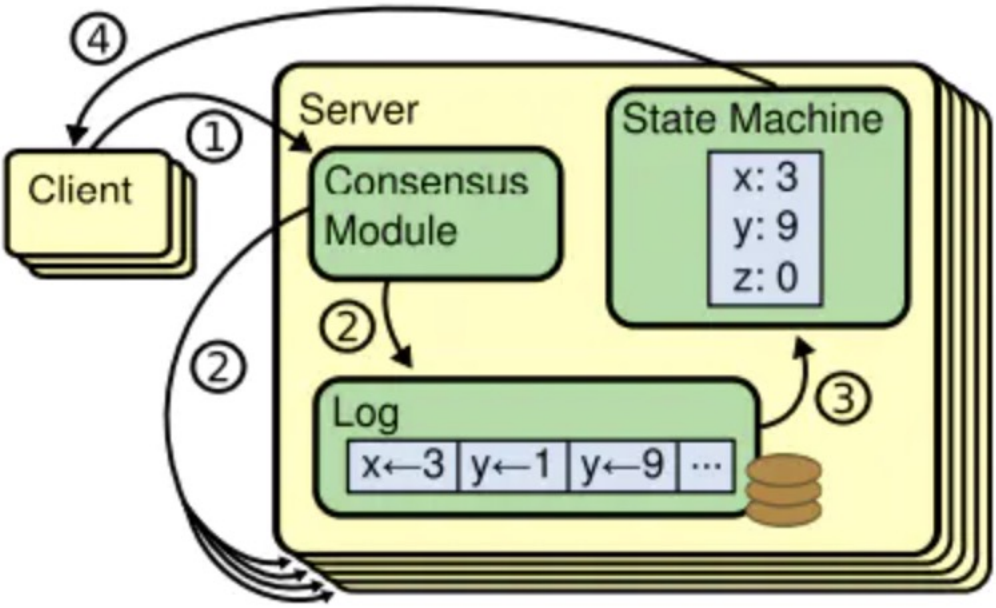
聊聊RAFT的一个实现(4)–NOPCOMMAND

### 3.4 一种极端场景




## 4. Log Replication(数据写入)

聊聊RAFT的一个实现(3)–commit




Step0. `Client` 发出 `WriteCommand`

Step1. 先写 `Leader` 的Log

Step2. 在通过AppendRequest，写 `Follower` 的Log

Step3. 执行 `Leader` 的Commit(写内存数据库)

Step4. 执行 `Follower` 的Commit

Step5. 给 `Client` 返回结果

**注意:** 写入动作，只能由 `Leader` 来发起, 在 `goraft` 中，它会拒绝 `WriteCommand`

> 只要client等到leader完成Commit动作。即使后续leader发生变更或部分节点崩溃，raft协议可以保证，client所提交的改动依然有效。

## 5. 数据读取&watch

### 5.1 默认consul有3种一致性模型

- default
- consistent
- stale

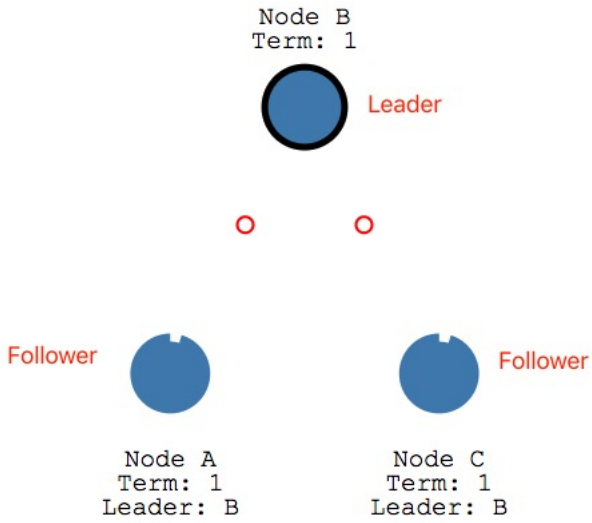
默认情况下，consul server(follower）不提供数据查询，仅转发请求给consul server(leader） consistency

其中consistent模式是强一致性的，其它两种模式都不能保证强一致性。用stale模式可以提高吞吐能力，当然数据短时间内可能会有不一致问题

### 5.2 `default` 和 `consistent` 模式的区别

### 5.3 如何使用stale模型

```
curl -v 'http://dev1:8500/v1/health/service/es?dc=dc1&passing=1&stale
```




**5.4 watch是怎么回事?**

玩转CONSUL(1)–WATCH机制探究