Redsync Algorithm - Distributed Lock Management using Redis

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Agenda

- Background
- Why DLM
- Examples of DLM
- Properties of DLM
- Redsync - Redis-Based Timed Mutual Exclusion Locks
- Discussion - Is this Design Correct?
- Criticism - Lack of Fencing Token
- Conclusion - Is Redsync the answer?

Drive the Agenda!

More questions = More Answers!
(PS: It is lovely to learn as much as possible!)

Background - Lock Manager

- Correct Use of Shared Resource
  - ★ Example - who will process an incoming event?
  - ★ Example - who writes to the DB?
  - ★ Example - who can concatenate a file part?

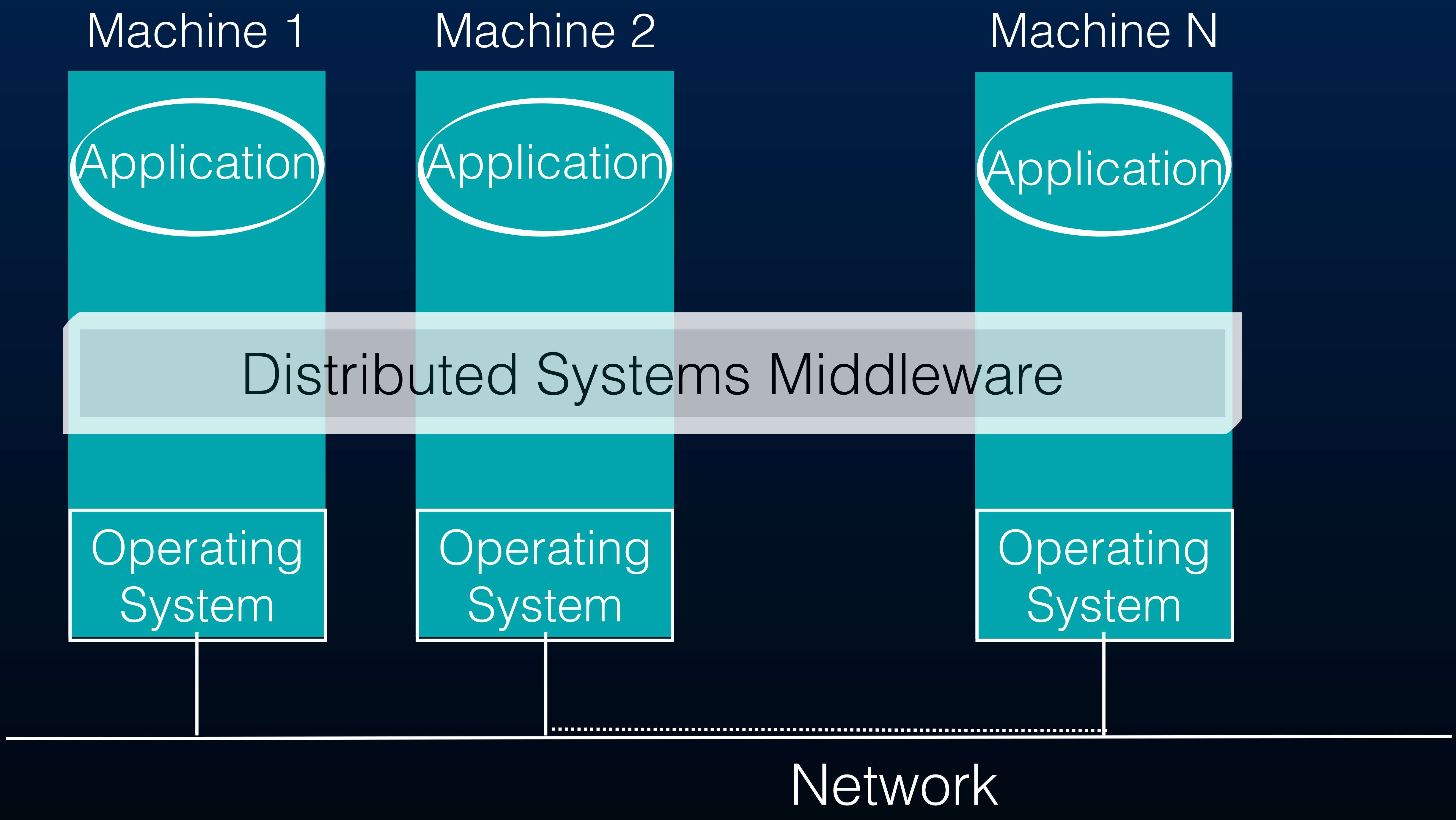
- Reducing Redundancy in task processing

- Distributed Resource
  - ★ Resource that is managed by several entities

Distributed System

A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable.

- Lamport


Machine 1
Machine 2
Machine N
Application
Application
Application
Distributed Systems Middleware
Operating System
Operating System
Operating System
Network

Distributed Lock Manager (DLM)

- Eliminates single point failure - Lock Manager running over a cluster
- Every node holds information on locks (Will that always be complete?)
- Differences versus a centralised solution? (Hint: PACELC)

Examples of DLM

- Apache Zookeeper
- Apache Helix
- Google's Chubby
- ETCD
- Consul
- Redsync
- …

Redis

- In-memory data store
- Supports strings, lists, sets, hashes, range queries…

```
root@smita-virtual-machine#
telnet localhost 15000
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
GET str
$0
SET str new string
+OK
GEt str
$9
newstring
SAVE
+OK
ZADD set 3 "three"
:1
ZADD set 2 "two"
:1
ZADD set 4 "four"
:1
ZRANGE set 0 2 withscores
*6
$5
"two"
$1
2
$7
"three"
$1
3
$6
"four"
$1
4
SAVE
+OK
```

*UT Logs from github.com/csesmita/myredis

Properties of DLM

Safe Lock

- Exactly one client holds lock
- Lock Released - By exactly the client that currently holds it

Properties of DLM

Deadlock-free Lock

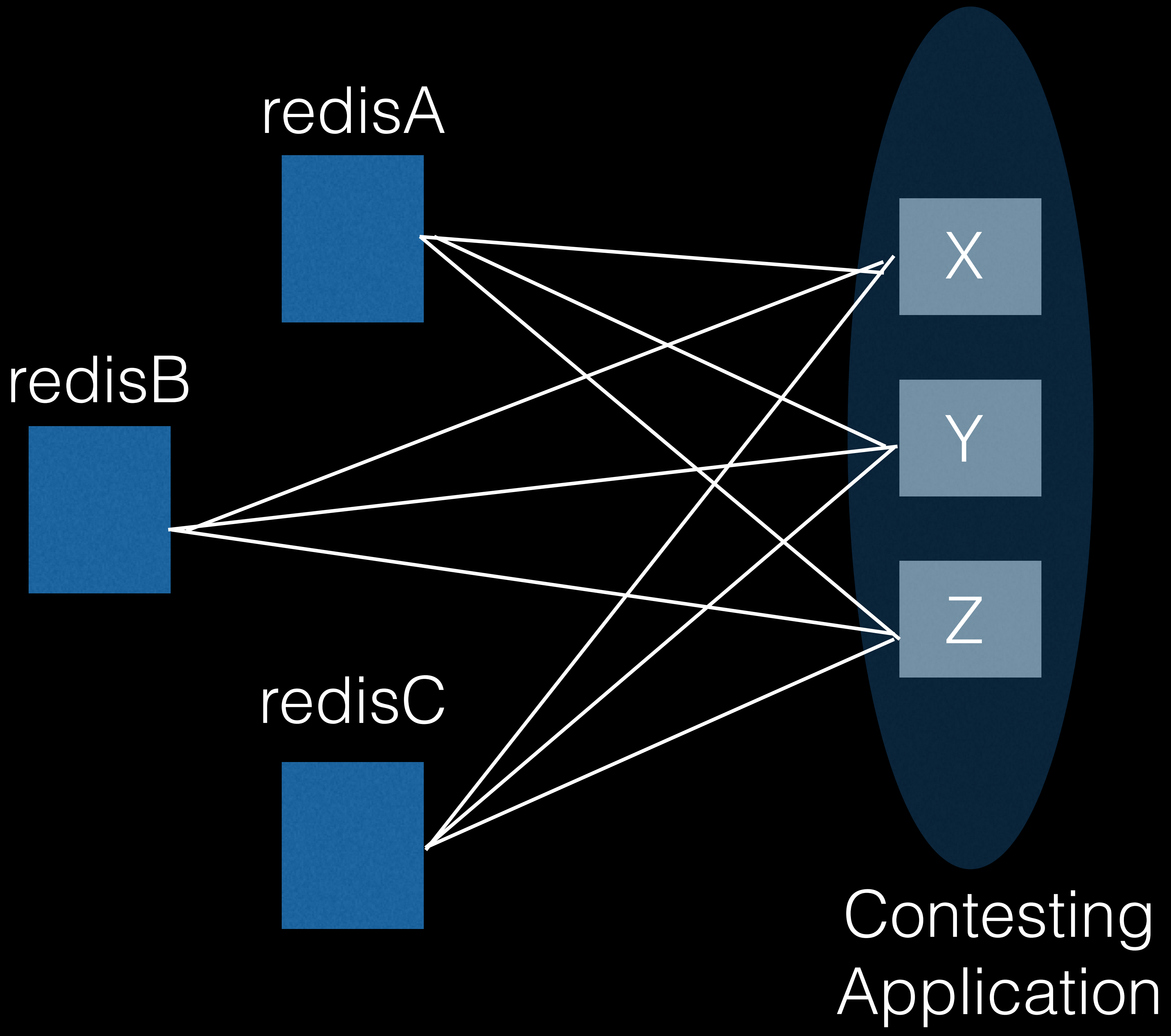
- Client waiting on a lock eventually granted

Properties of DLM

Fault Tolerant

- Minimum of N/2 + 1 cluster nodes up
- Else ?

Cluster of Redis Nodes



Redis-Based Lock

SET Command’s Optional Parameters

EX seconds -- Set the specified expire time, in seconds.

PX milliseconds -- Set the specified expire time, in milliseconds.

NX -- Only set the key if it does not already exist.

XX -- Only set the key if it already exist.

SET lockName signature NX PX 30000

Question - Why is a signature needed? (Hint: The job took longer than expected, and a new node acquired the lock assuming the task wasn’t finished.)

Creating Redis Connection Pool

Define Redis Pools of Connection - using Redigo of pool
https://github.com/garyburd/redigo

For each Redis addr in list do -

```
pool[i] = &redis.Pool{
    MaxIdle:     3,
    IdleTimeout: 240 * time.Second,
    Dial: func() (redis.Conn, error) {
        return redis.Dial("tcp", addr.String())
    },
}
addr: net.Addr type
```

Creating Mutex

Couple of ways -

For each shared resource do-

m, err := redsync.NewMutexWithGenericPool("SharedResource", pools)

where pools := []redsync.Pool{}
and N = len(pools)
or,

m,err := NewMutex"SharedResource", redisAddrs)

redisAddrs- List of Redis node addresses
Quorum - N/2 + 1 (strictly greater than one half the size of pools)

Parameters

```
//How long the lock is valid in seconds
m.Expiry = 4 * time.Second

//How many times to try and acquire lock
m.Tries = 10

//Delay between two successive attempts to acquire lock (ms)
m.Delay = 500 * time.Millisecond

//Clock drift factor - How far apart are the clocks?
m.Factor = 0.001
```

Locking the Mutex

```
err := m.Lock()
/*
 * 1. For each Redis node
 *       a. gets connection
 *       b. sets signed lock for expiry time only if not set
 *       c.If set, increment count
 * 2. If Quorum reached within validity -> Success.
 * 3. Else, delete all locks set in 1.
 * 4. Decrement retries count
 * 5. Pause for delay between retries.
 * 6. If max tries reached -> Failure. Else goto 1.
 */
```

Reset timeout of Mutex - Touch

```
err := m.Touch()
/*
 * 1. For each Redis node
 *       a. gets connection
 *       b. sets signed lock for expiry time only if set with value
 *       c.If set, increment count
 * 2. If Quorum reached -> Success.
 * 3. Else Failure.
 */
```

This API is now called Extend() and returns a bool.

Unlocking the Mutex

```
err :=m.Unlock()
/*
 * 1. For each Redis node
 *       a. gets connection
 *       b. deletes signed lock only if set with value
 *       c.If set, increment count
 * 2. If Quorum reached -> Success.
 * 3. Else Failure.
 */
```

Discussion

- Are there scenarios where safety is not guaranteed?
- What is the complexity of this solution?

Criticism - Lack of Fencing Token

- Monotonically increasing token
- Storage server checks token
- Accepts forward requests
- Rejects backward requests

Conclusion

Design Considerations -

- Use Case - Identify critical paths
- Can system accept a few violations to safety?
- How will storage behave under ordinary cases?
- Learning curve for the solution
  - ★ This kept us away from Zookeeper
  - ★ But, there are curator recipes

Suggested Reading and References

- Distributed locks with Redis
- How to do distributed locking
- Is Redlock safe?

Introduce Yourself!

Tell Us…

- Your Name, where you work and background
- Your passion
- Most inspiring speaker from Go community or otherwise
- Would you like to be a part of study group?
- Would you like to lead the next session?