Distributed Rate Limiting

The main idea is to have ***"client rate limiting"***, that is, continue to have multiple nodes making requests to a single resource, but observing a common, shared request rate limit.

Actors & Participants

Redis Token Bucket

A rate limiting token bucket in **Redis**, is basically a `key` holding an integer value.

This buckets initially start with a `0` value.

Resetter

Multiple simple background worker nodes, in which only one is active through *"leader-election"*, elected leader will periodically *"reset"* a bucket stored in **Redis**, that is, set it to `0`.

Consumers

Worker/consumer nodes, in this case, they would be `mparticle-sync` nodes that make requests to **mParticle**.

Consumers request a rate limiting token, if token is valid, make request to **mParticle**, otherwise, skip processing.

How it works

A *rate limit bucket* is basically a counter in a ***Redis*** key, which is accessible from all consumers.

Whenever a consumer needs to make a request to an upstream service, it has to make a ***Redis*** `INCR` call to the corresponding bucket.

This call, will increase its value, and then give it back as the result value for the ***Redis*** call.

A ***maximum*** number of calls per a certain period of time is known and shared by all consumers.

If the value obtained from **Redis** is above the ***maximum***, the consumer is not allowed to make a request to the upstream service.

If the value is at or below the ***maximum***, the upstream requests is completed normally.

The ***Resetter*** process makes a `SET` call to **Redis** every `N` milliseconds, to set the bucket count back to zero (0).

This allows to continue making requests to the upstream service while keeping a limited rate of them as configured.

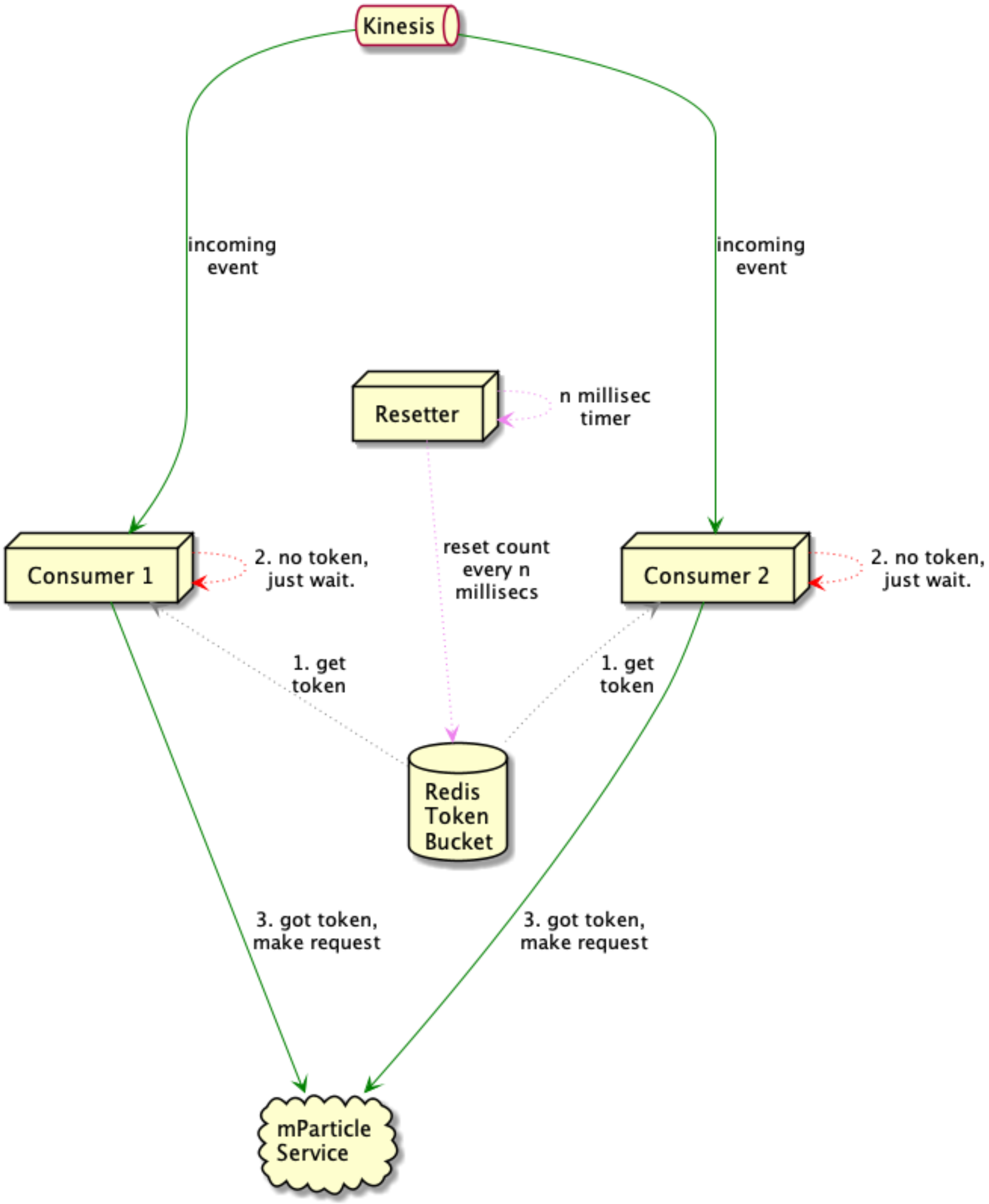
For **mParticle** case, you could have `30k max reqs per 1000ms`, `15k max reqs per 500ms`, or `10k per 330ms`, all of them would serve approximately the same effect, but benchmarks should be run to arrive to an optimum value.

Imagining an example of `10k max reqs per 1000ms`, might lead to making all `10k` requests within the first `100ms`, which could still cause issues, followed by `900ms` of idle time. It is possible that a configuration of `5k max reqs per 500ms` or other variant might be more appropriate.

Deploy Spec

Consists of:

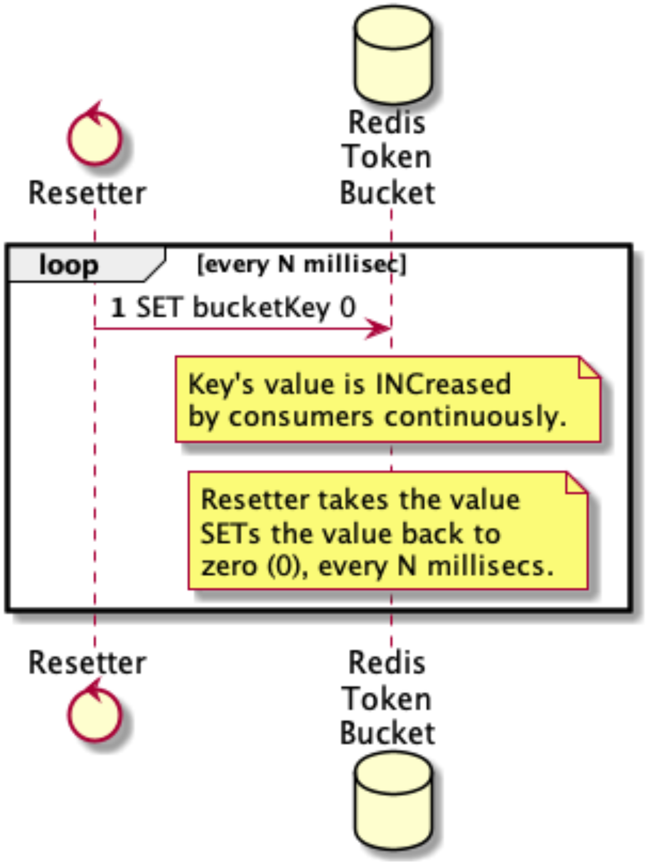
- Redis database holding token bucket(s).
- Resetter process *"feeding"* `N` tokens every `M` milliseconds.
- Consumers getting tokens, and making requests to service if token was valid.


Kinesis
incoming event
incoming event
Resetter
n millisec timer
Consumer 1
2. no token, just wait.
reset count every n millisecs
Consumer 2
2. no token, just wait.
1. get token
1. get token
Redis Token Bucket
3. got token, make request
3. got token, make request
mParticle Service

Resetter Lifecycle

Simply goes and resets to zero (0) the count of requests since last reset.

This *“Reset”* process runs every `M` milliseconds.



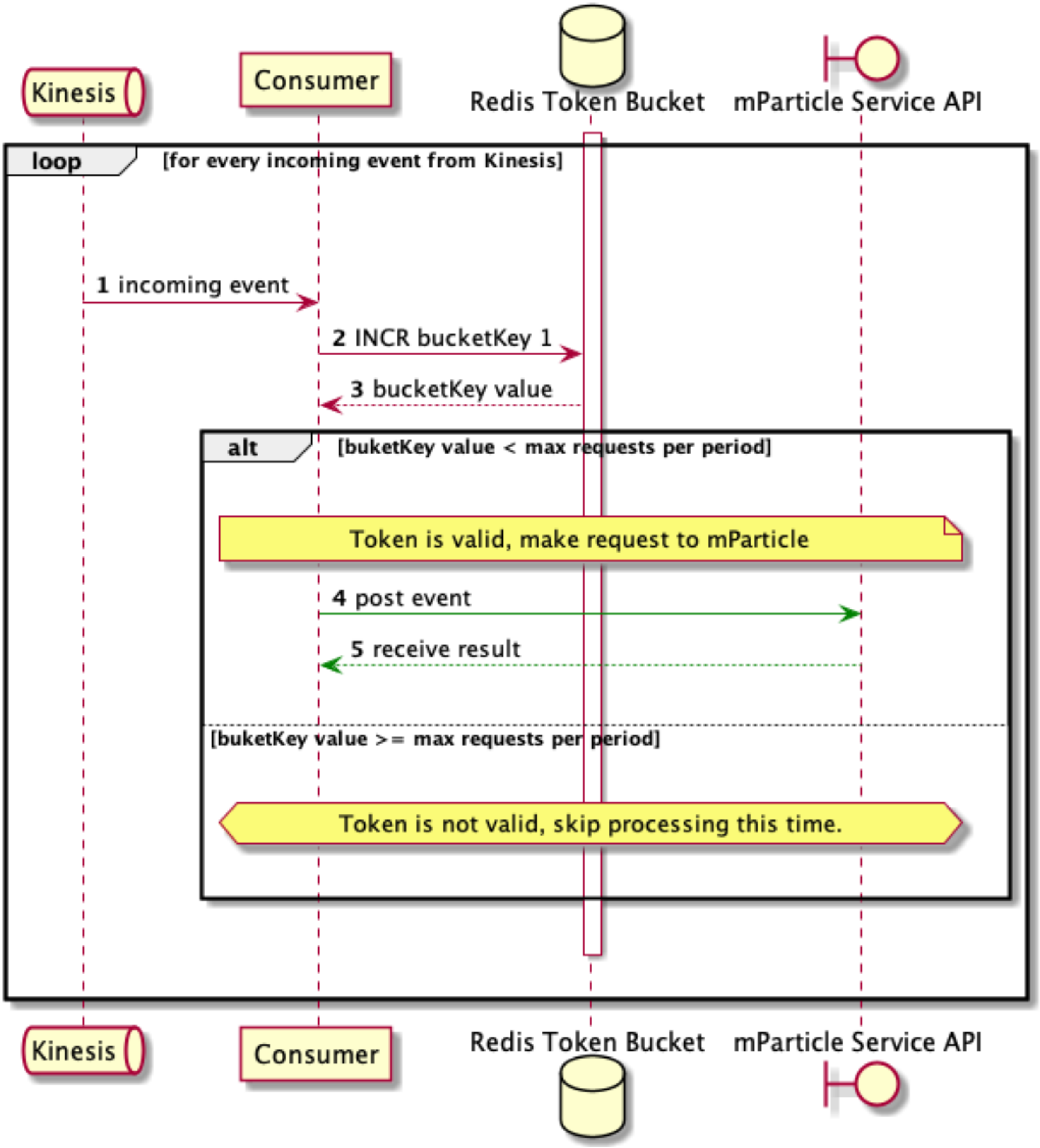
Consumer Lifecycle

Makes a request to upstream service, **ONLY** if it was able to fetch a “*valid*” token.

Every request for the *token*, increases its value.

In this example, a *“valid”* token is one that is *below* a maximum number of requests per a certain period of time.

If the token retrieved is greater than said maximum, no processing is done.

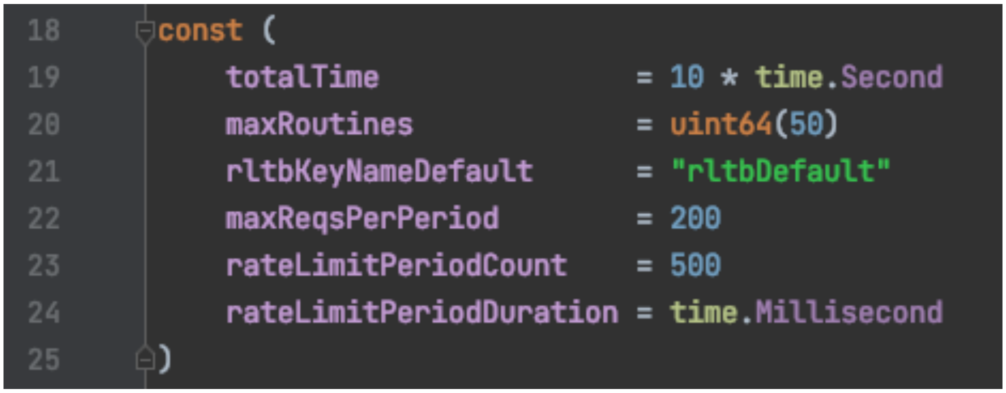

Kinesis
Consumer
Redis Token Bucket
mParticle Service API
loop
[for every incoming event from Kinesis]
1 incoming event
2 INCR bucketKey 1
3 bucketKey value
alt
[buketKey value < max requests per period]
Token is valid, make request to mParticle
4 post event
5 receive result
[buketKey value >= max requests per period]
Token is not valid, skip processing this time.
Kinesis
Consumer
Redis Token Bucket
mParticle Service API

Proof Of Concept

Configuration

This is the configuration used for this POC, it shows a rate limit of approximately `200 max reqs per 500ms`.

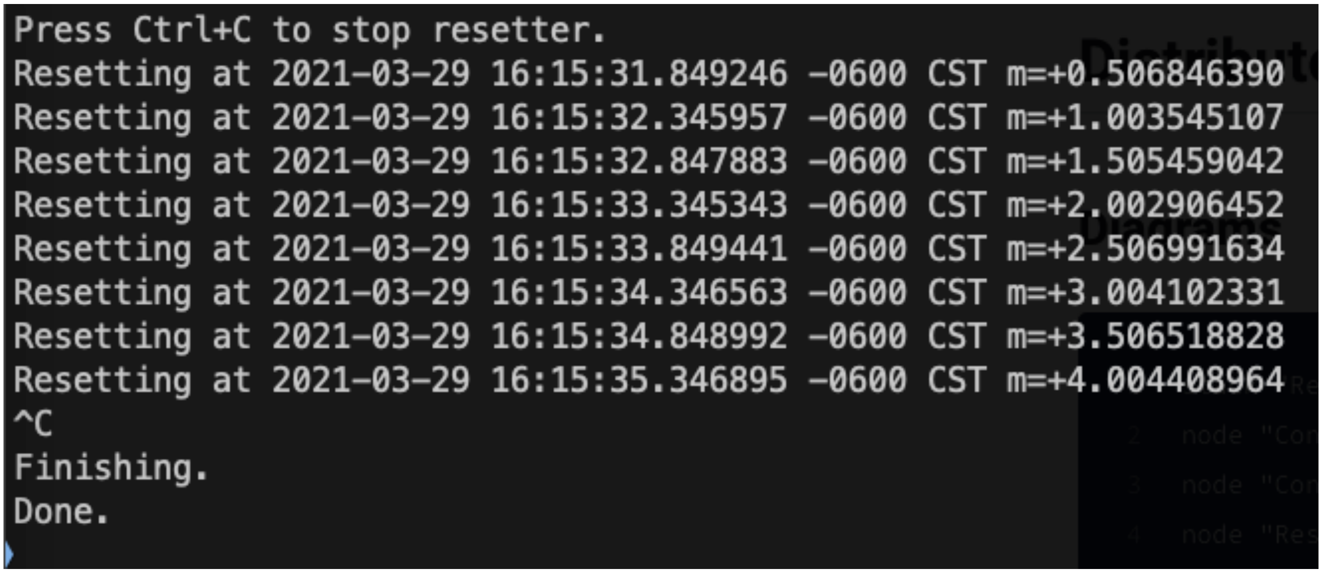
A **Redis** key name of `"rltbDefault"`, `50` ***goroutines*** per process spawned, and the test will run for a total of `10 seconds`.



```go
const (
	totalTime                 = 10 * time.Second
	maxRoutines               = uint64(50)
	rltbKeyNameDefault        = "rltbDefault"
	maxReqsPerPeriod          = 200
	rateLimitPeriodCount      = 500
	rateLimitPeriodDuration = time.Millisecond
)
```

Resetter

Here you can see a sample run of a resetter running every `500ms`.



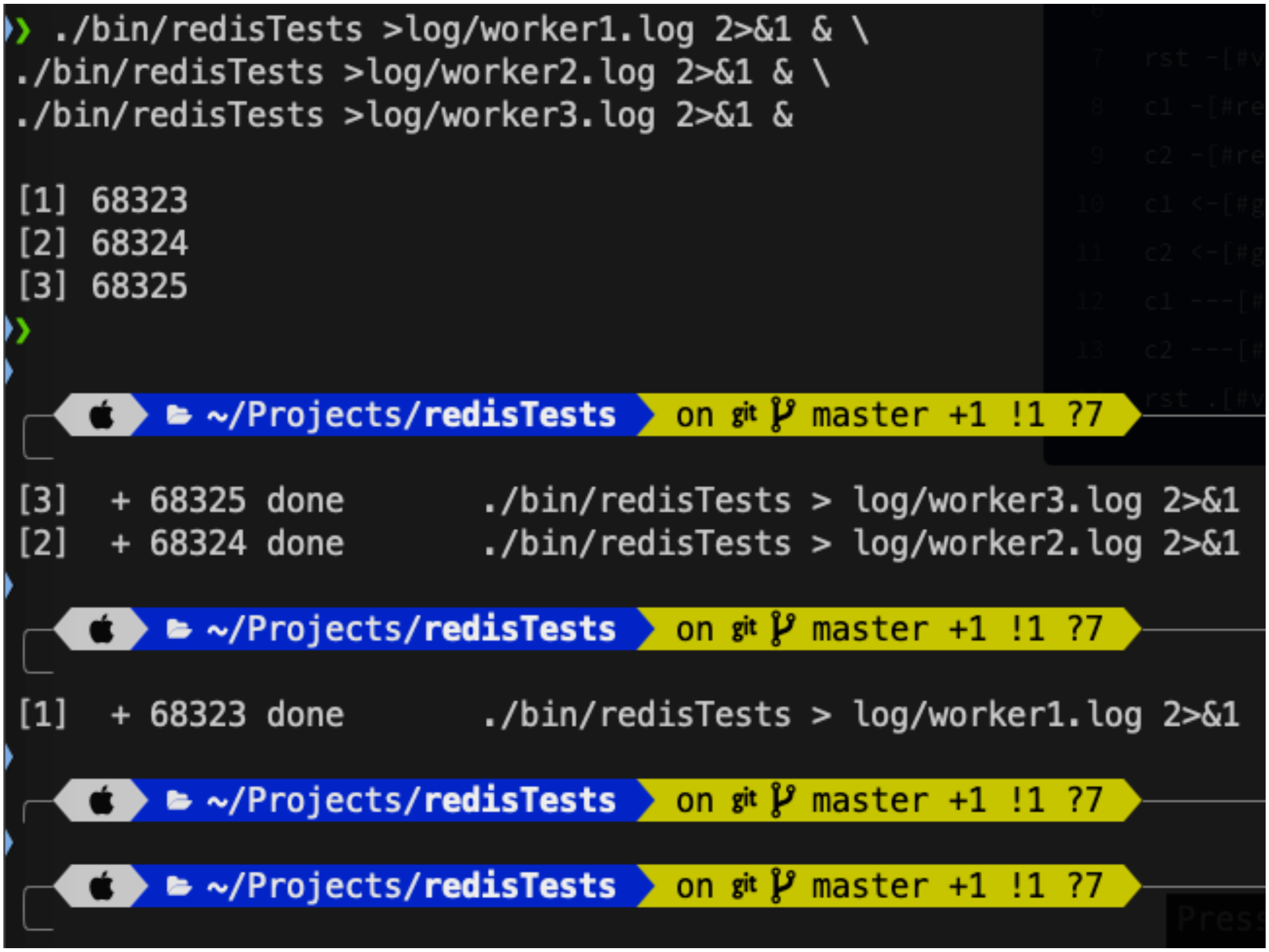
```
Press Ctrl+C to stop resetter.
Resetting at 2021-03-29 16:15:31.849246 -0600 CST m=+0.506846390
Resetting at 2021-03-29 16:15:32.345957 -0600 CST m=+1.003545107
Resetting at 2021-03-29 16:15:32.847883 -0600 CST m=+1.505459042
Resetting at 2021-03-29 16:15:33.345343 -0600 CST m=+2.002906452
Resetting at 2021-03-29 16:15:33.849441 -0600 CST m=+2.506991634
Resetting at 2021-03-29 16:15:34.346563 -0600 CST m=+3.004102331
Resetting at 2021-03-29 16:15:34.848992 -0600 CST m=+3.506518828
Resetting at 2021-03-29 16:15:35.346895 -0600 CST m=+4.004408964
^C
Finishing.
Done.
```

Consumers

Here 3 workers are launched, each one of them logging to its own log file.

Each of this 3 workers have a pool of 50 go routines making simultaneous requests to the upstream service.

The upstream service is a simple, local json-server simply returning `{ "status": "ok" }` for every request,
yet, it has a limit on the laptop used for testing, of serving around 500 requests per second, but it’s enough for POC purposes.



```
❯ ./bin/redisTests >log/worker1.log 2>&1 & \
./bin/redisTests >log/worker2.log 2>&1 & \
./bin/redisTests >log/worker3.log 2>&1 &

[1] 68323
[2] 68324
[3] 68325
❯

   ~/Projects/redisTests  on git master +1 !1 ?7

[3]  + 68325 done       ./bin/redisTests > log/worker3.log 2>&1
[2]  + 68324 done       ./bin/redisTests > log/worker2.log 2>&1

   ~/Projects/redisTests  on git master +1 !1 ?7

[1]  + 68323 done       ./bin/redisTests > log/worker1.log 2>&1

   ~/Projects/redisTests  on git master +1 !1 ?7

   ~/Projects/redisTests  on git master +1 !1 ?7
```

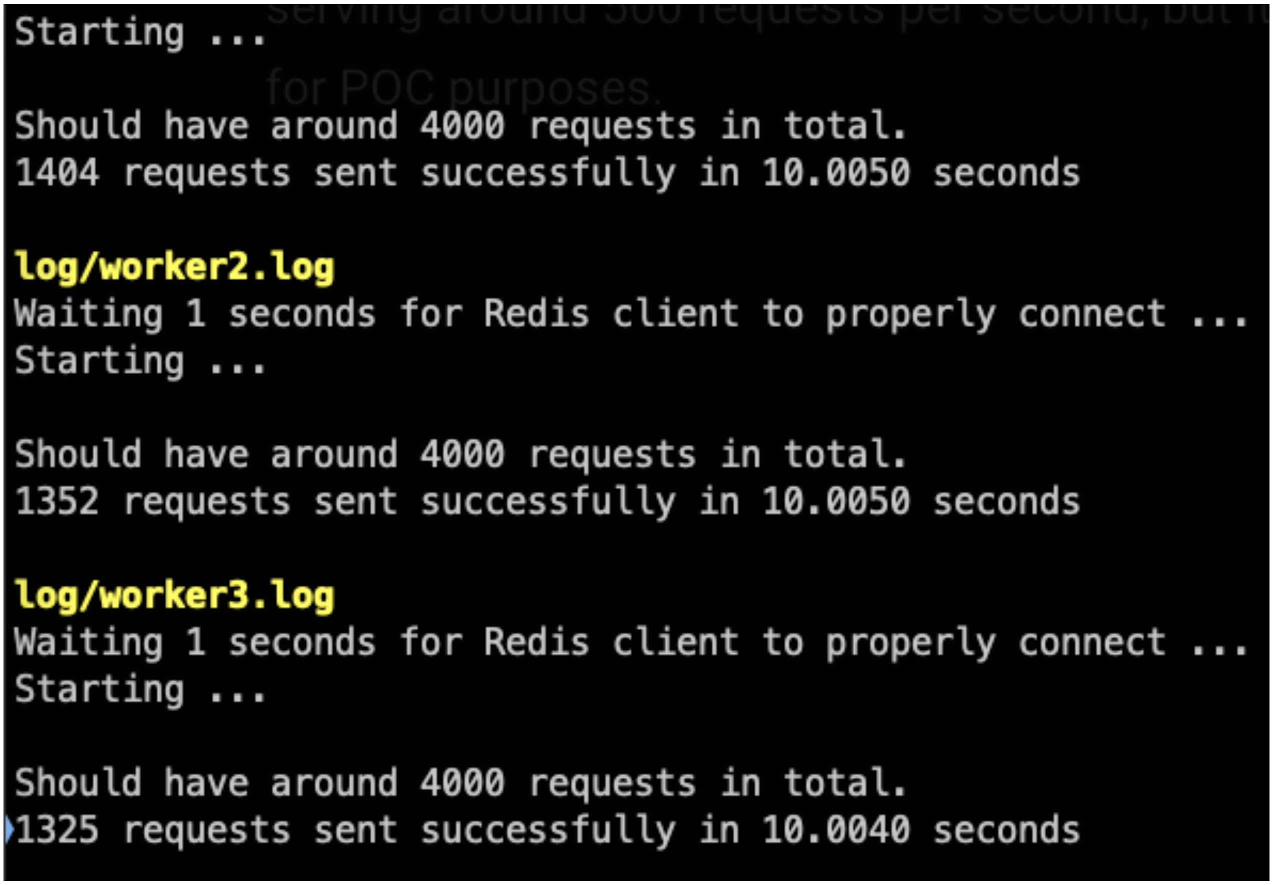
Results

This shows an example of a test run. It shows a few messages, but the most important to notice is that, given the current rate limit configuration, it says `Should have around 4000 requests in total.`.

The sum of `1404` + `1352` + `1325` yields `4081` total requests in `~10s`, which is approximately the requested rate limit of `200 max reqs per 500ms` (which is 400 per second, and 4000 per 10 seconds) in the sample configuration.

serving around 500 requests per second, but i

for POC purposes.



```
Starting ...

Should have around 4000 requests in total.
1404 requests sent successfully in 10.0050 seconds

log/worker2.log
Waiting 1 seconds for Redis client to properly connect ...
Starting ...

Should have around 4000 requests in total.
1352 requests sent successfully in 10.0050 seconds

log/worker3.log
Waiting 1 seconds for Redis client to properly connect ...
Starting ...

Should have around 4000 requests in total.
1325 requests sent successfully in 10.0040 seconds
```