μ-Service Resiliency With Circuit Breakers

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Resilience

Resiliency is defined as the capability of a system to maintain its functions and structure in the face of internal and external change and to degrade gracefully when it must.

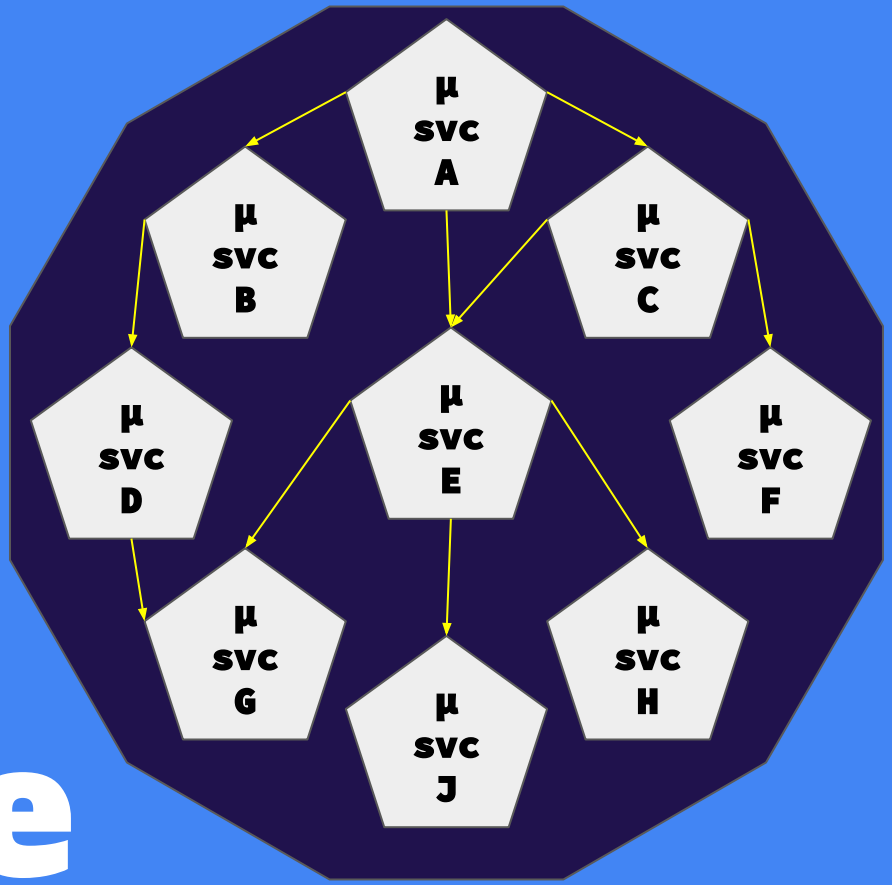
TOWARD INHERENTLY SECURE AND RESILIENT SOCIETIES
Brad Allenby, Jonathan Fink

http://science.sciencemag.org/content/309/5737/1034.full

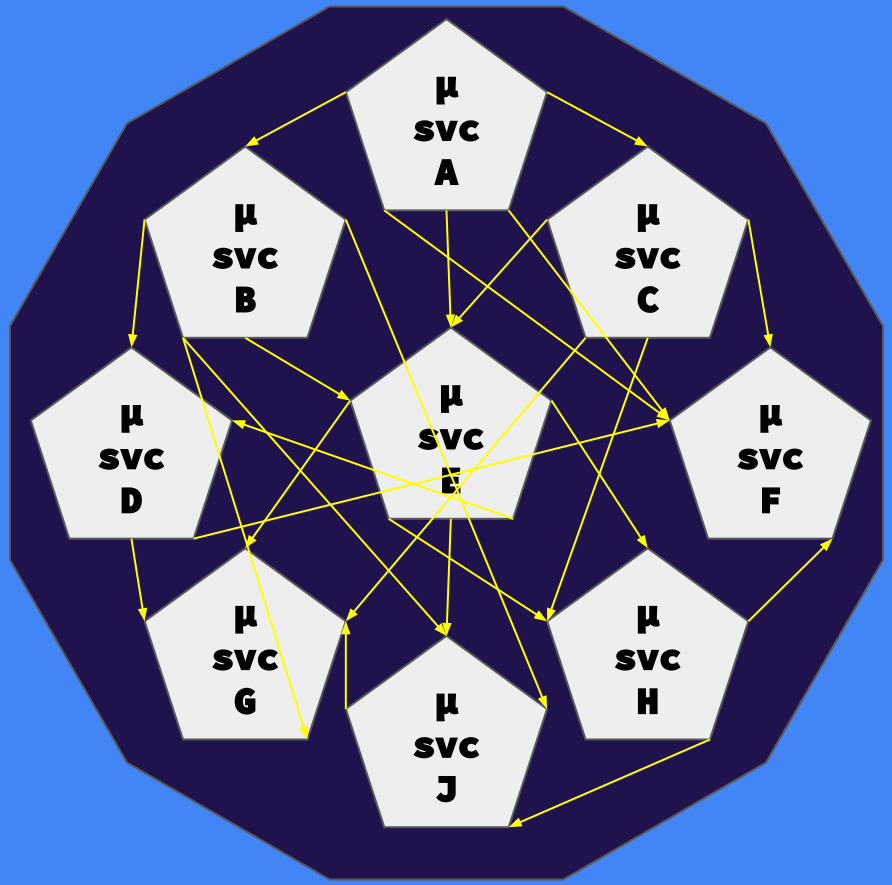
Microservices

My App

µ-Service

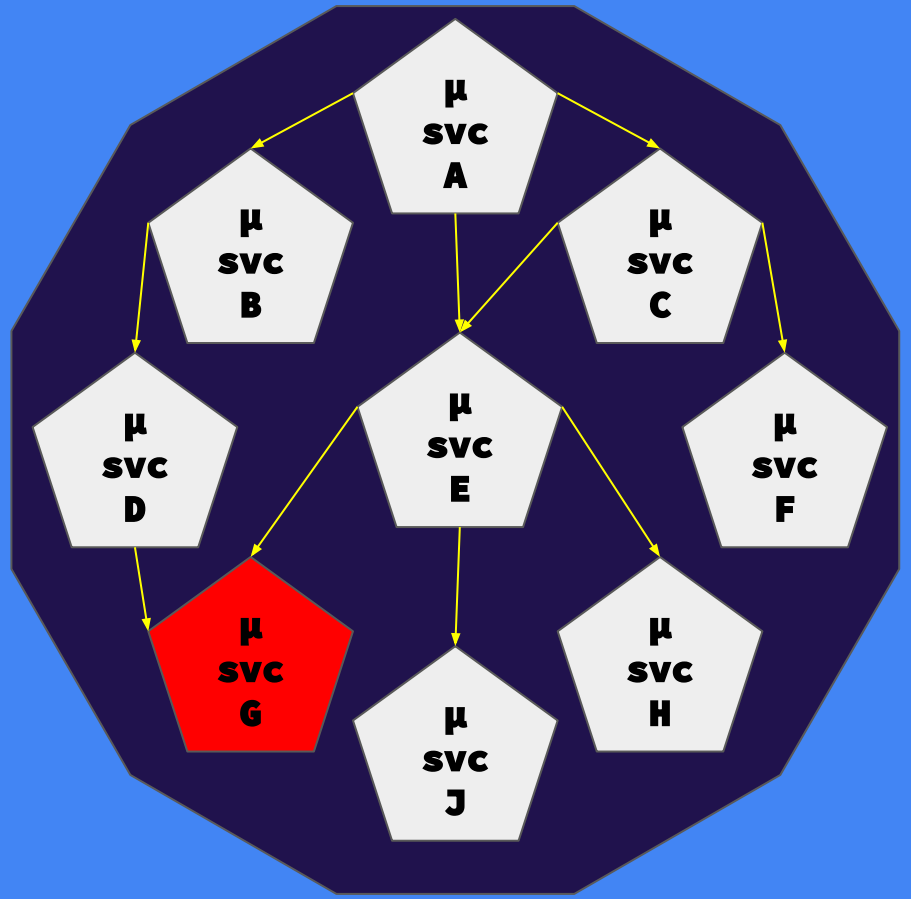


Reality



Microservices are not a Panacea

A Single Failure



```
function wait (timeout) {
 return new Promise(resolve => {
   setTimeout(resolve, timeout)
 });
}
```

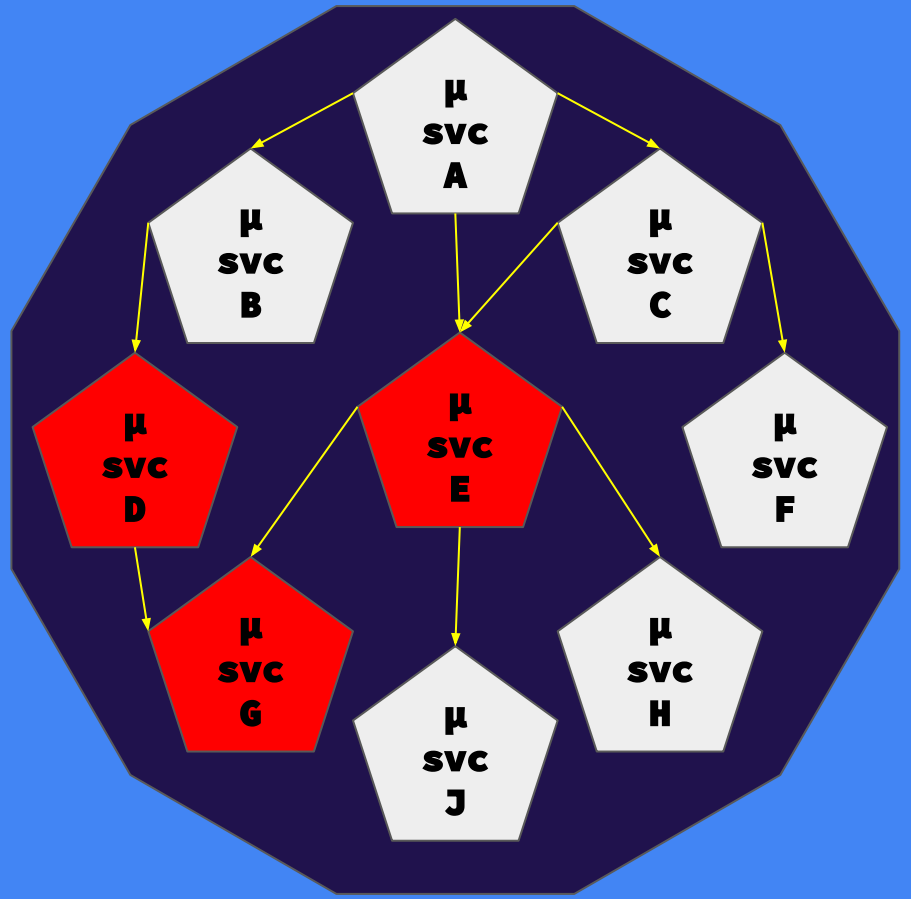
A Simple Sleep in µ-Service D

```
const MAX_ATTEMPTS = 10;
let retryAttempts = 0;

async function fetchData (url) {
 return request.get(url).then(formatData)
   .catch(err => {
     if (retryAttempts > MAX_ATTEMPTS) return Promise.reject(err);
     retryAttempts++;
     await wait(500);
     return fetchData(url);
   });
}
```

A Naive Implementation

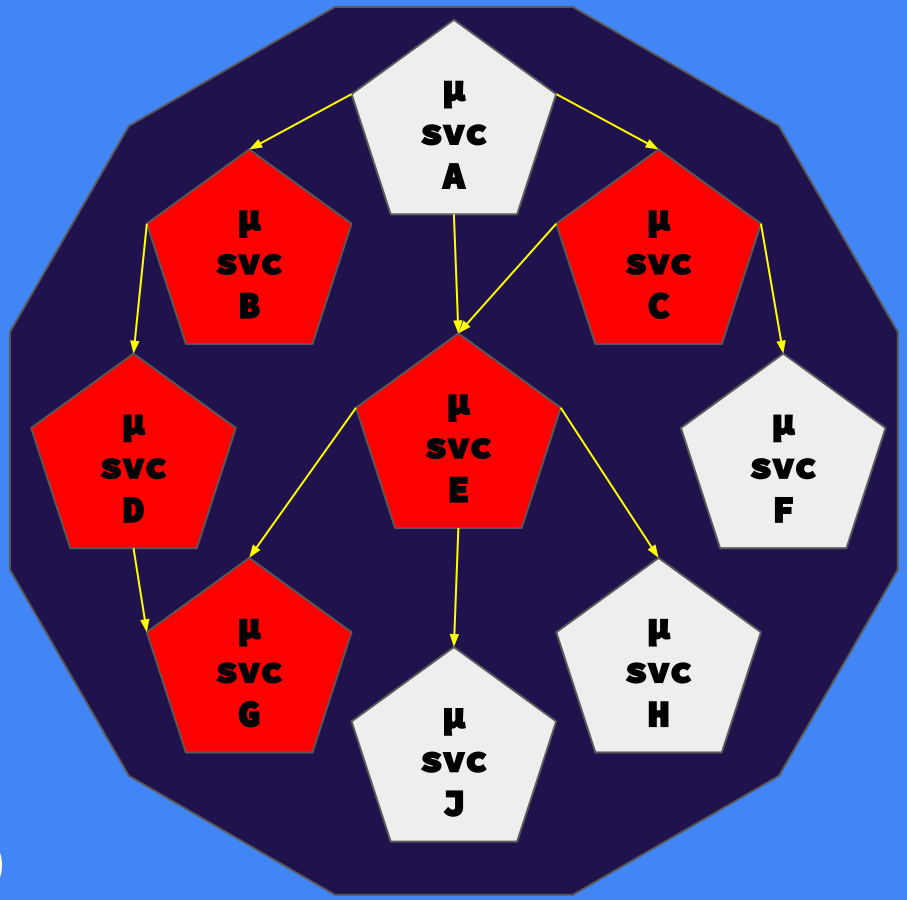
What Happens When We Keep On Trying?

Services D & E Block

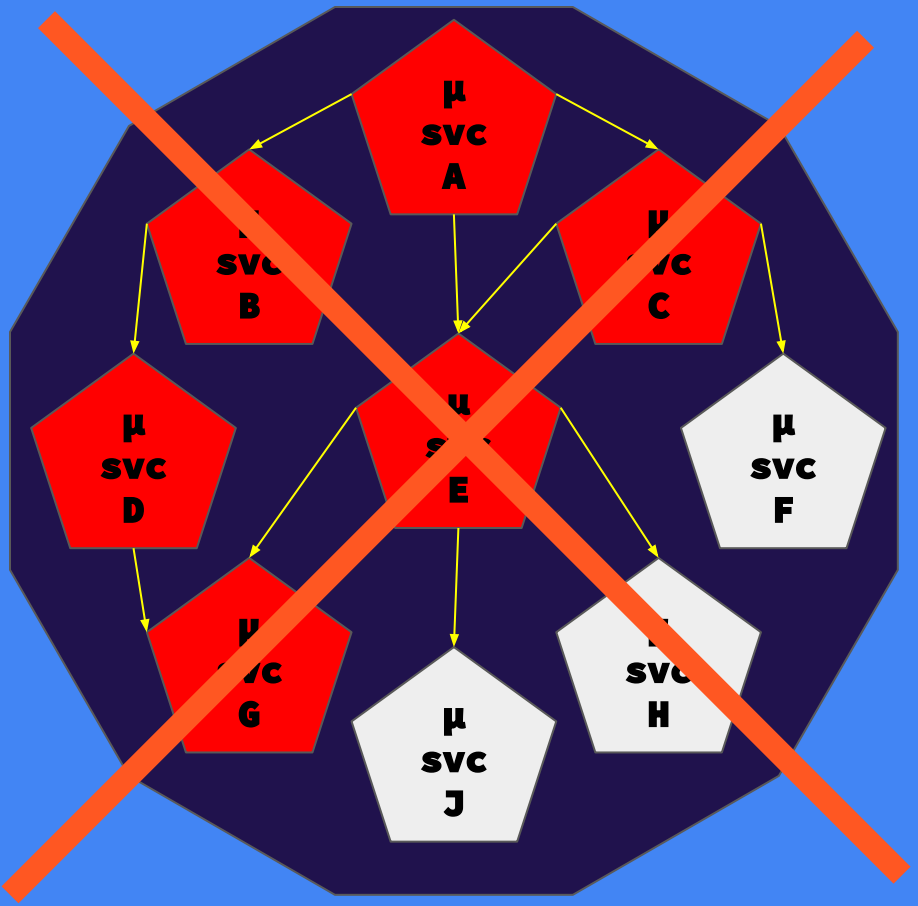


It Gets Worse

Failure Cascades



Unto Death



Naive Implementations are a Band-Aid

Resilience

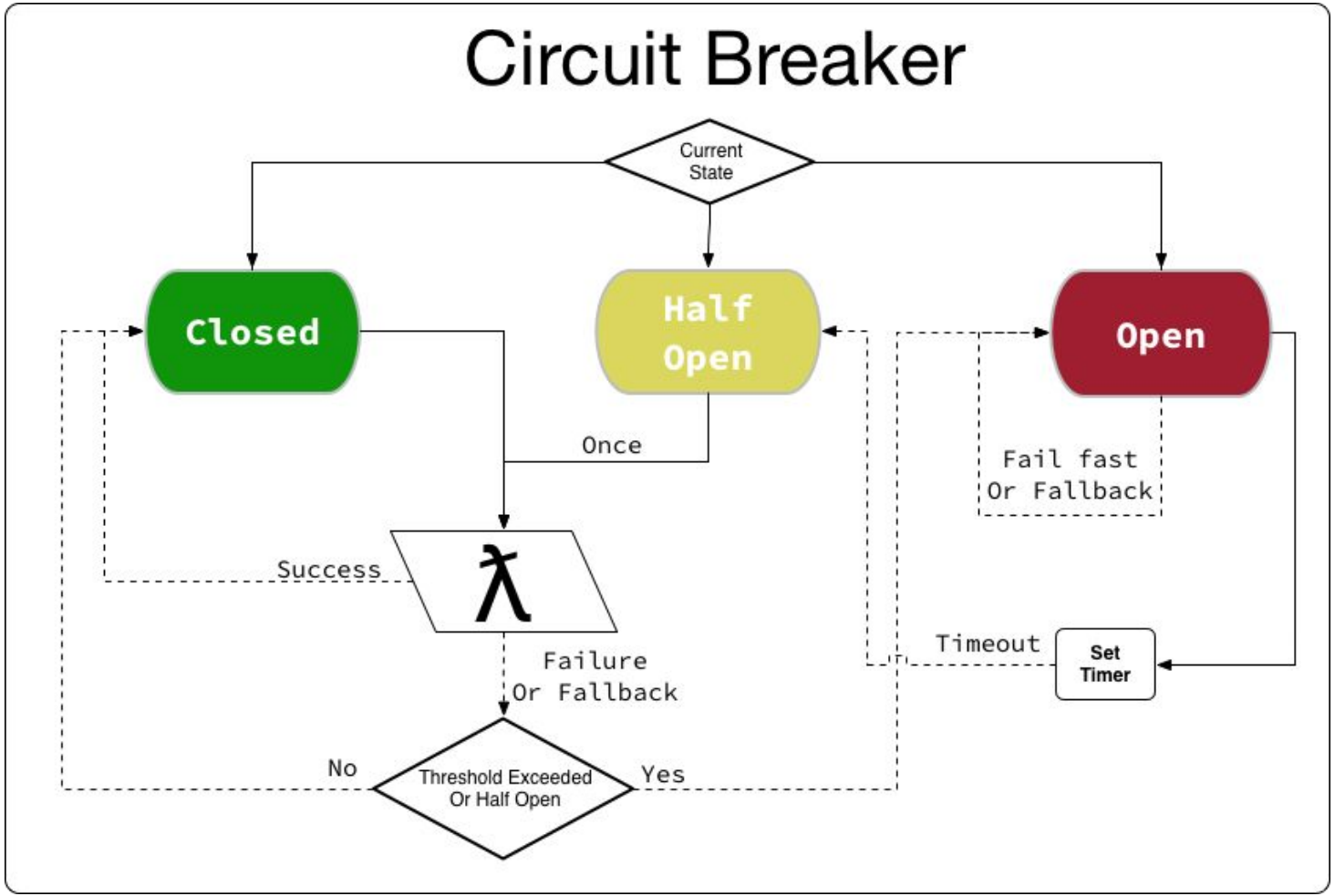
Do not have the same error reoccur constantly.

Handle the error quickly and gracefully without waiting for TCP timeout.

Resiliency Patterns

- Fault and latency tolerant
- Stops cascading failures
- Provides fallback behavior
- Fails fast with graduated automatic recovery

Circuit Breakers


Circuit Breaker
Current State
Closed
Half Open
Open
Once
Fail fast
Or Fallback
Success
λ
Timeout
Set Timer
Failure
Or Fallback
No
Threshold Exceeded
Or Half Open
Yes

```
function fetchData (url) {
  return _ => {
    // return a promise
    return request.get(url)
      .then(formatData)
      .catch(err => {
        // do something more sensible than this
        console.log(err)
      });
  };
}
```

A Function: It Might Fail

```
const CircuitBreaker = require(‘opossum’);

const options = {
  timeout: 1000,
  errorThresholdPercentage: 50,
  resetTimeout: 5000,
  capacity: 10
};

const circuit = CircuitBreaker( fetchData('/some/url'), options );
```

Wrap it in a Circuit Breaker

Fallback Behavior

```
circuit.fallback(
  _ => 'Sorry, out of service right now'
);

circuit.on('fallback',
  result => reportFallbackEvent(result));
```

Fallback Events

Events

- ★ fire
- ★ success
- ★ failure
- ★ open
- ★ close
- ★ halfOpen
- ★ fallback
- ★ cacheHit
- ★ cacheMiss
- ★ timeout
- ★ semaphore-locked
- ★ health-check-failed
- ★ snapshot

Events

Health Checks

```
function memoryUsage () {
  const memory = process.memoryUsage();
  return (memory.heapUsed / memory.heapTotal) < 0.9 ?
    Promise.resolve() : Promise.reject();
}

circuit.healthCheck(memoryUsage);
circuit.on('health-check-failed', sendAlertMessage);

function sendAlertMessage () {
 // send an alert message to someone
}
```

Example: Health Checks

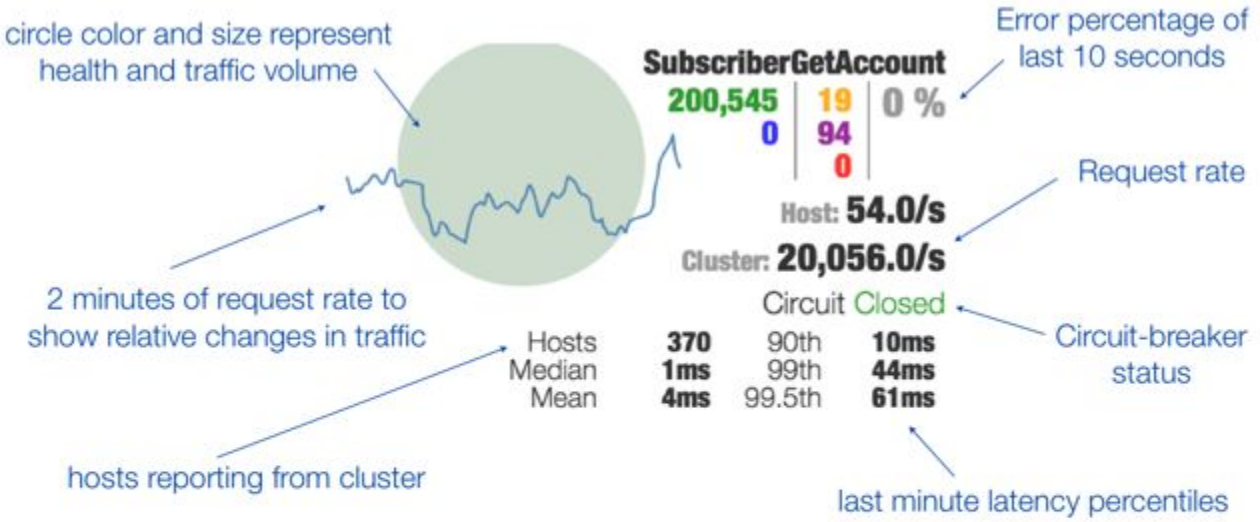
Snapshots

```
// Creates a 10 second window consisting of ten time slices,
// each time slice being 1 second long.
const circuit = circuitBreaker(fs.readFile,
{ rollingCountBuckets: 10, rollingCountTimeout: 10000});

// get the cumulative status for the last second
circuit.status.on('snapshot', data => ( /* store data? */ ));

// get the array of 10, 1 second time slices
circuit.status.window;
```

Example: Snapshots

Statistics

Statistics Snapshots



Rolling 10 second counters
with 1 second granularity

Successes	200,545	19	Thread timeouts
Short-circuited (rejected)	0	94	Thread-pool Rejections
		0	Failures/Exceptions

```
const app = express();
const circuit = CircuitBreaker( callTheRemoteApi );

app.use(‘/stats.stream’, function statStream (request, response) {
  response.writeHead(200, {
    'Content-Type': 'text/event-stream',
    'Cache-Control': 'no-cache',
    'Connection': 'keep-alive'});
  circuit.stats.pipe(response);
};
```

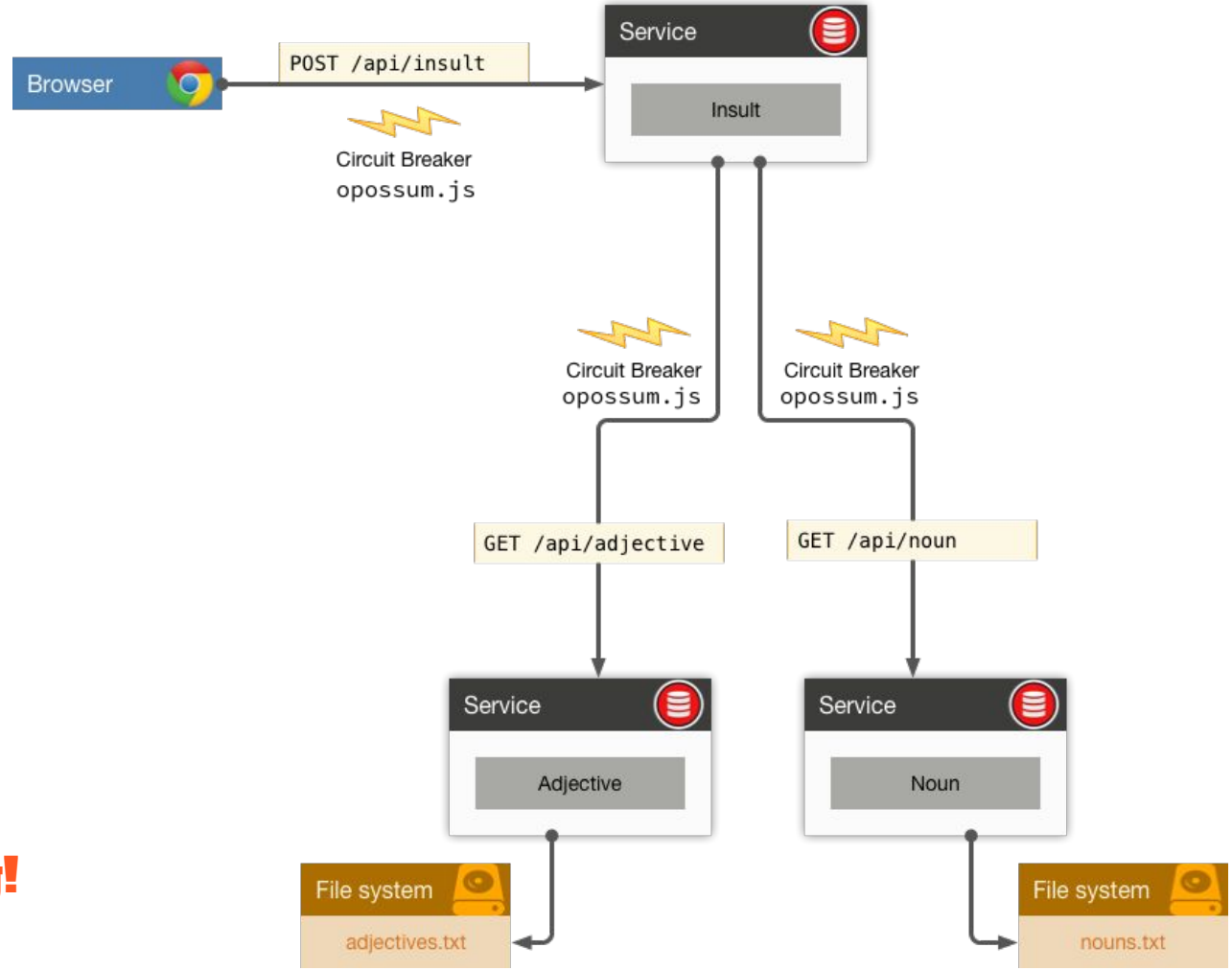
Statistics Stream on the Server

```
// in the browser
const stats = new EventSource('/stats.stream');
stats.onmessage = updateStats;

function updateStats(message) {
  const stats = JSON.parse(message.data);
  $('#stats').html(message.data);
  $('#failures').html(stats.errorCount);
  $('#fires').html(stats.requestCount);
  $('#latency-mean').html(stats.latencyTotal_mean.toFixed(2));
}
```

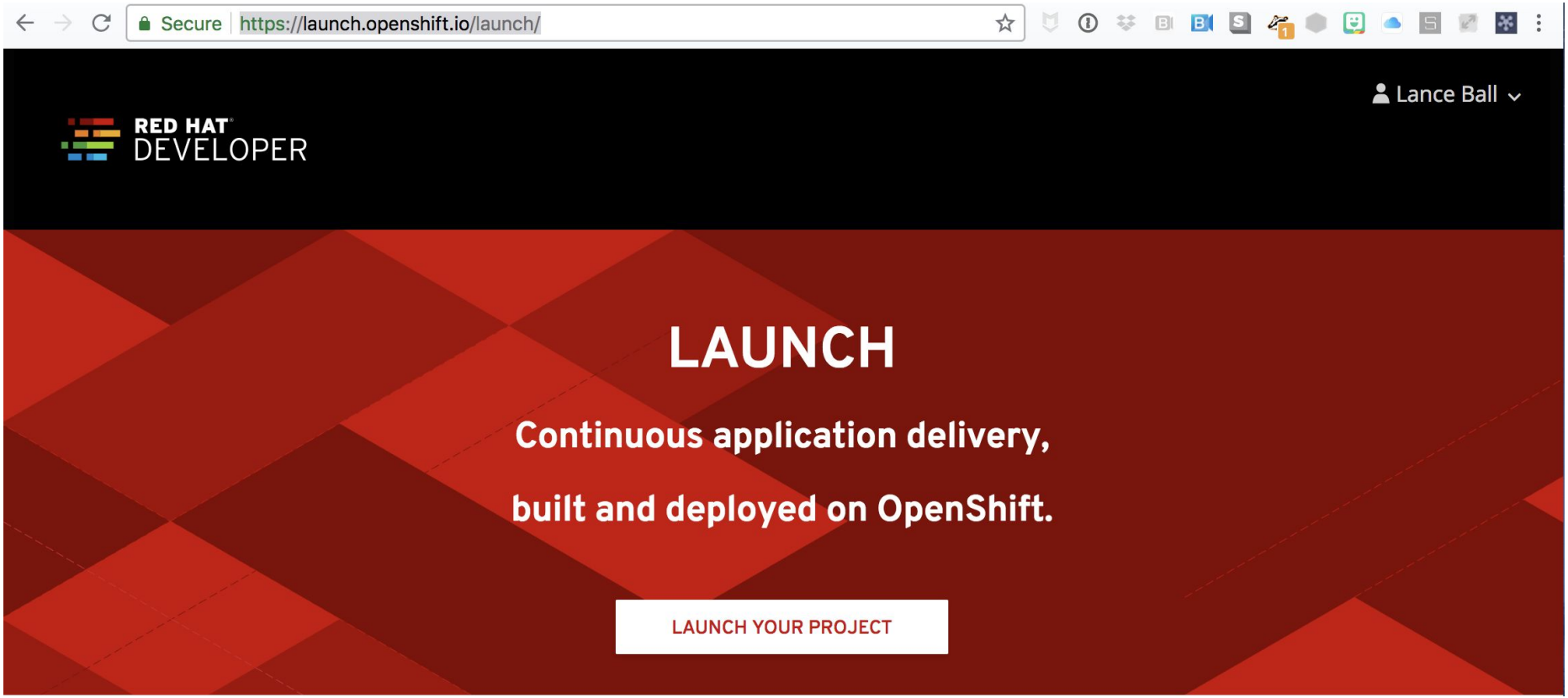
Statistics Stream in the Browser

Elizabethan Insults

Demo Time!


Browser
POST /api/insult
Service
Insult
Circuit Breaker
opossum.js
Circuit Breaker
opossum.js
Circuit Breaker
opossum.js
GET /api/adjective
GET /api/noun
Service
Adjective
Service
Noun
File system
adjectives.txt
File system
nouns.txt

Insulting!



https://launch.openshift.io

Thanks & Questions

https://launch.openshift.io

https://github.com/bucharest-gold/nodejs-circuit-breaker

https://github.com/lance/elizabethan-insults

https://github.com/bucharest-gold/opossum