



SmartThings

Make your world smarter.

Ryan Applegate

Scaling Grails at





Who am I

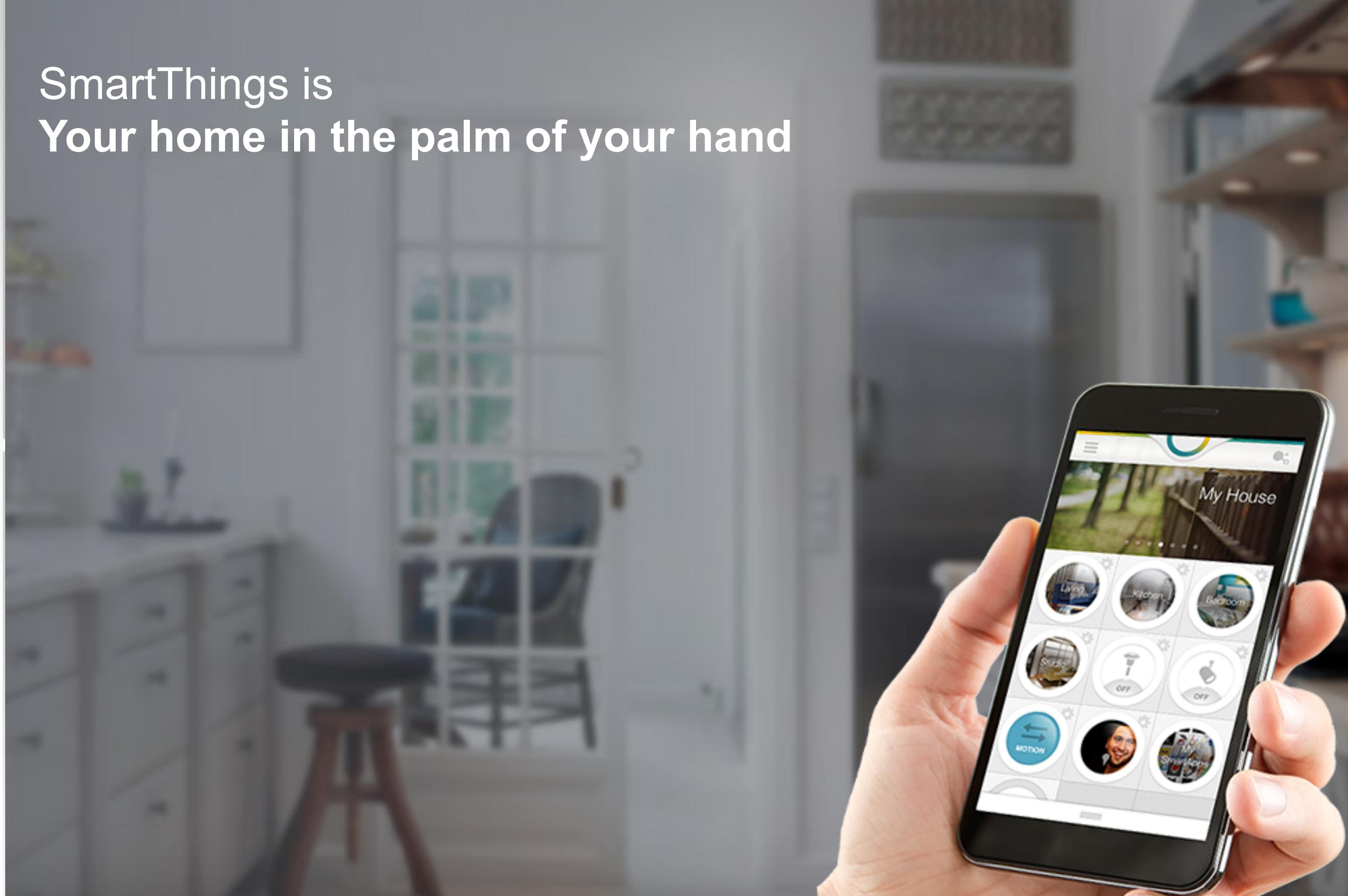
- Ryan Applegate
- Lead Software Architect @ SmartThings
- @rappleg on Twitter and GitHub

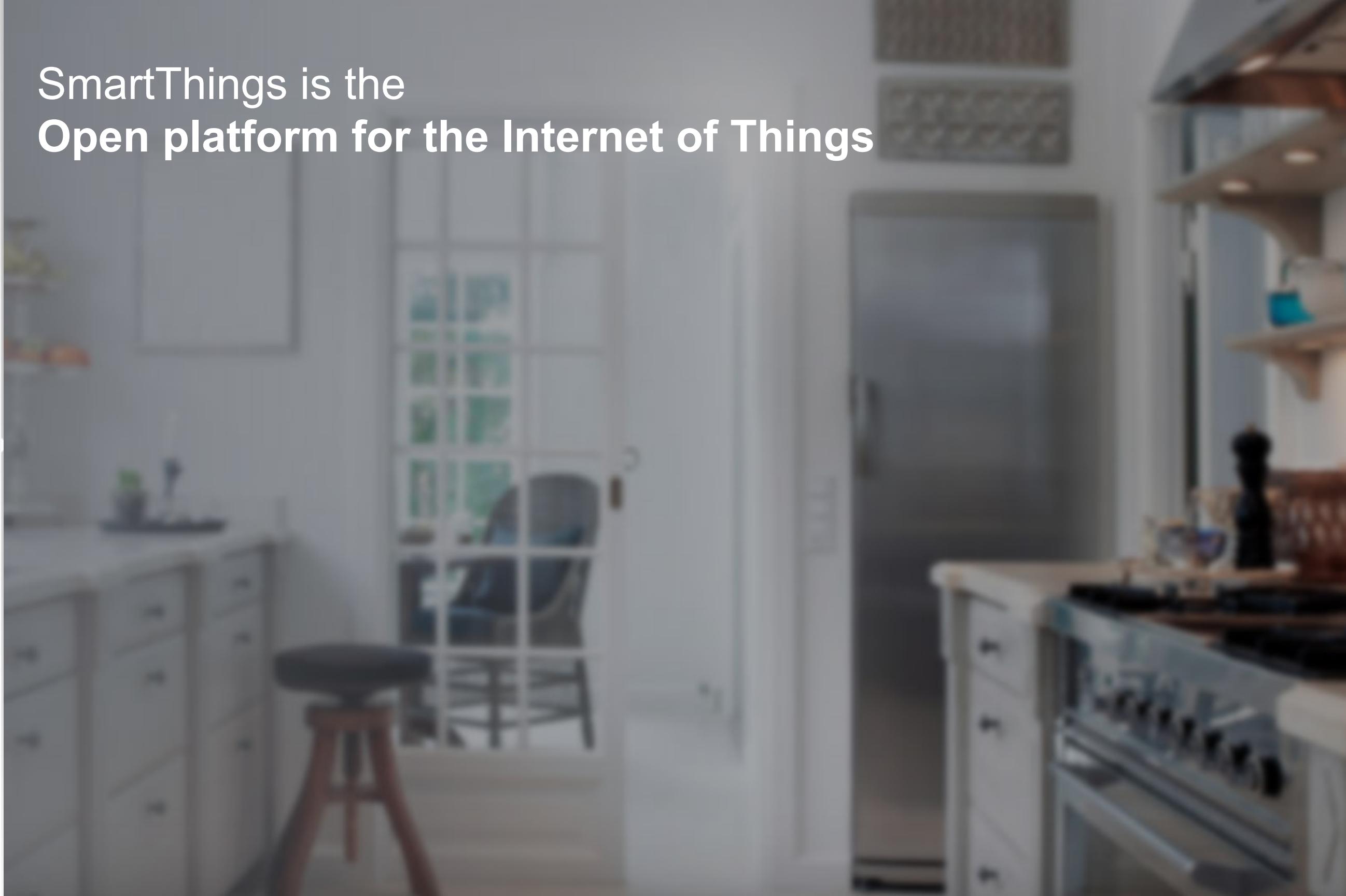


Agenda

What is SmartThings?
Building/Deploying a Grails monolith
Databases
Caches
JVM Tuning with Groovy
Rate Limiting
When you outgrow your plugins
Where do we go from here?

SmartThings is
Your home in the palm of your hand



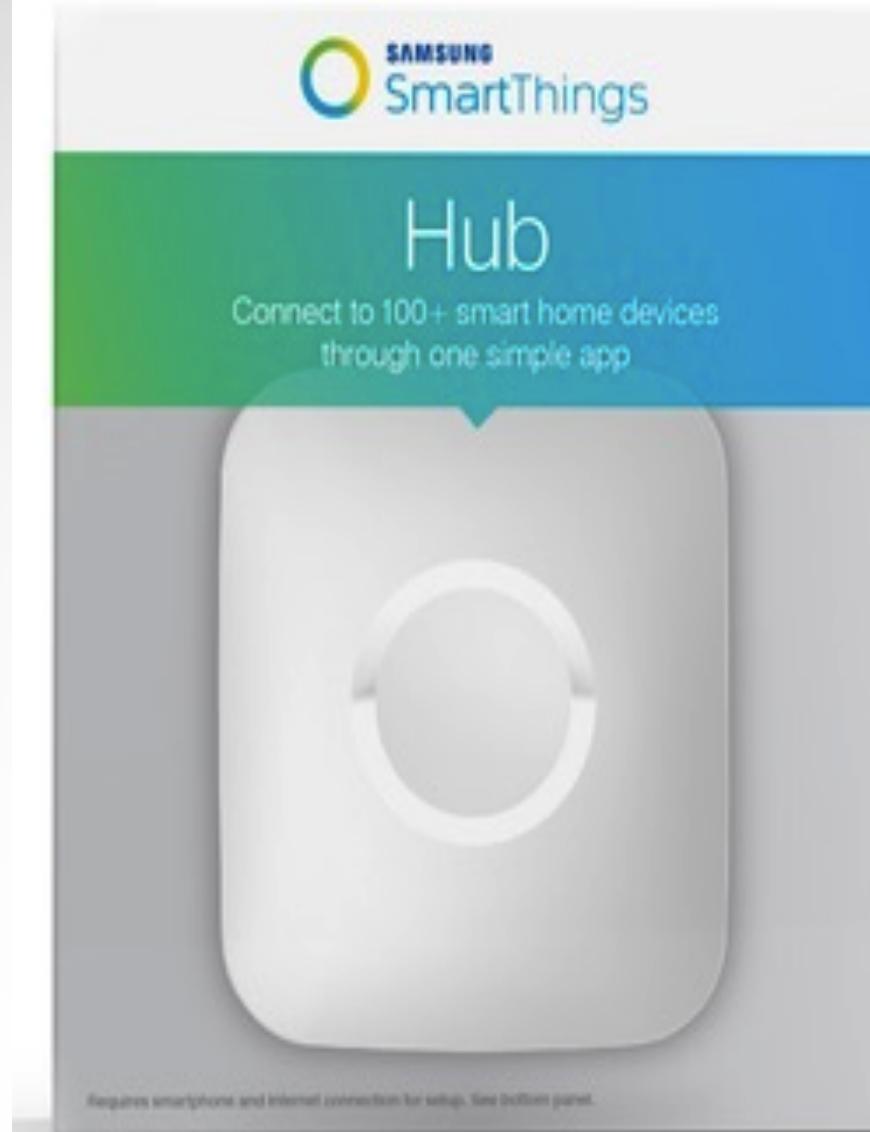
A blurred background image of a modern kitchen interior. It features light-colored cabinetry, a dark countertop with a built-in oven, and a window above a sink. A small dining area with a round table and chairs is visible in the background.

**SmartThings is the
Open platform for the Internet of Things**



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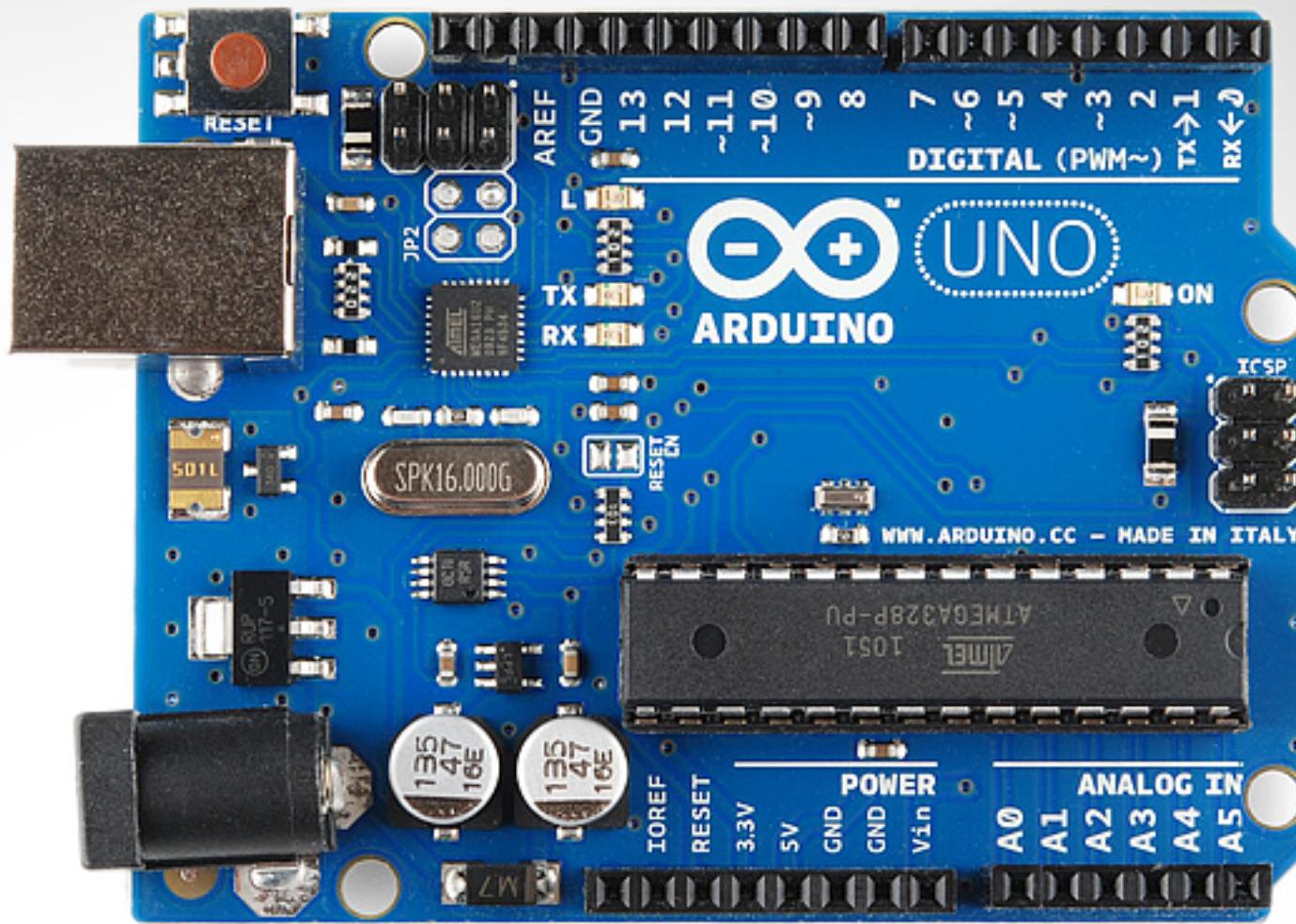
BEGINNER'S GUIDE

CONTROL HUNDREDS OF DEVICES WITH ONE APP.

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Building a monolith

Core cloud platform (Deployed to AWS)

Grails was a great fit for startup needs

- APIs for mobile clients
- Rabbit for queue processing
- MySql DB (RDS)

Codebase grew fast ~ 175k LOC



Deploying a monolith

Same Grails codebase deployed with different configurations as separate clusters

- API (mobile clients, etc...)
- Devices (messages from devices)
- SmartApps (device subscriptions)
- Scheduler (execute at a certain time)
- System Jobs, etc...

Clusters are for isolated workloads, predictability, and scalability



Canary Deployments

Deploy a single instance with new code

Can be to any set of clusters or shards

Zero-Downtime deployments

Monitoring metrics on the canary to determine if the deploy should be rolled back or forward before shutting down old servers

- CPU
- DB connections
- Error rates
- Latency



Monitoring Tools

DataDog (Dropwizard metrics, etc...)

SumoLogic (Log aggregation, dashboards)

MonYOG (RDS monitoring)

AppDynamics (Application tracing)

OpsCenter (Cassandra)

PagerDuty (Alerting)

AWS console (CloudWatch, etc...)



Databases

MySQL (RDS)
Cassandra (CQL Java driver)

Querying

GORM
Criteria
HQL
SQL





Many to Many Gotcha

DeviceType

```
static belongsTo = Capability  
statichasMany = [  
    capabilities: Capability  
]
```

Capability

```
statichasMany = [  
    deviceTypes: DeviceType  
]
```

How expensive is `deviceType.addToCapabilities(...)`?



Manage many to many yourself

DeviceType

```
static transients = ['capabilities']
Set<Capability> getCapabilities() {
    CapabilityDeviceType.findAllByDeviceTypeId(this.id).collect {
        it.capability
    } as Set
}
```

Capability

```
static transients = ['deviceTypes']
Set<DeviceType> getDeviceTypes() {
    CapabilityDeviceType.findAllByCapabilityId(this.id).collect {
        it.deviceType
    } as Set
}
```



Implementing mapping table

```
class CapabilityDeviceType implements Serializable {  
  
    DeviceType deviceType  
    Capability capability  
  
    static CapabilityDeviceType create(DeviceType dt, Capability c) {  
        new CapabilityDeviceType(deviceType: dt, capability: c)  
    }  
    ...  
}
```

CapabilityDeviceType.create(deviceType, capability)



Transactional Overhead

- Persistent store to MySql DB (max ~5600 connections per instance)
- Need to be mindful of DB connections and overhead caused by unnecessary transactions
 - `@Transactional` causes check to `tx_isolation` to start
 - Commit at the end to persist changes to the DB
 - JDBC pool exhaustion is very expensive



Default Grails transactional behavior

```
class FooService {  
  
    String getFoo() {  
        return "bar"  
    }  
}
```

Is getFoo() transactional?



Transactional true by default

```
class FooService {  
    static transactional = true  
  
    String getFoo() {  
        return "bar"  
    }  
}
```

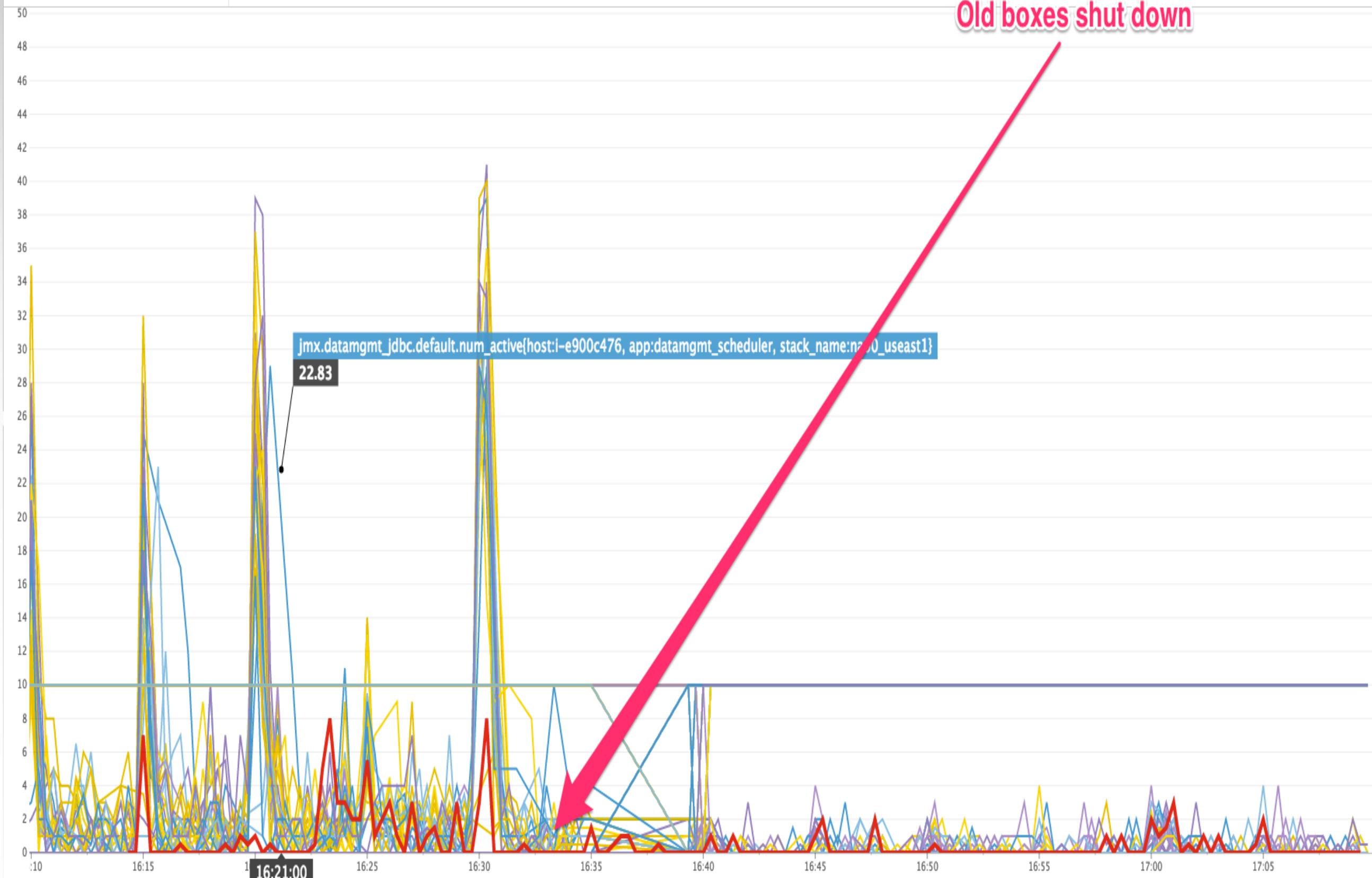


Turning off transactions if not needed

```
class FooService {  
    static transactional = false  
  
    String getFoo() {  
        return "bar"  
    }  
}
```

Old boxes shut down

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Using @Transactional

```
import org.springframework.transaction.annotation.Transactional

class FooService {

    @Transactional
    String getFoo() { return "foo" }

    String getBar() { return "bar" }
}
```

Is getBar() transactional?



Explicitly setting transactional = false

```
import org.springframework.transaction.annotation.Transactional

class FooService {
    static transactional = false

    @Transactional
    String getFoo() { return "foo" }

    String getBar() { return "bar" }
}
```



Transactional puzzler #1

```
import org.springframework.transaction.annotation.Transactional

class FooService {
    static transactional = false

    String getFoo() { return getBar() }

    @Transactional
    String getBar() { return "bar" }
}
```

Is getBar() transactional when called from getFoo()?



Don't use springframework

```
import grails.transaction.Transactional

class FooService {
    static transactional = false

    String getFoo() { return getBar() }

    @Transactional
    String getBar() { return "bar" }
}
```

Now getBar() will always be Transactional



readOnly configuration

```
import grails.transaction.Transactional

class FooService {
    static transactional = false

    Transactional(readOnly = true)
    String getFoo() {
        return getBar()
    }
}
```

```
dataSource.url = 'jdbc:log4jdbc:mysql:replication://
    foo.com:3306,foo_READONLY001.com:3306,foo-
    readonly002.com:3306/bar'
```



Transactional Puzzler #2

```
import grails.transaction.Transactional

class FooService {
    static transactional = false

    @Transactional
    String getFoo() { return getBar() }

    @Transactional(readOnly = true)
    String getBar() { return "bar" }
}
```

Is getBar() readOnly when called from getFoo()?



Propagation

```
import grails.transaction.Transactional

class FooService {
    static transactional = false

    @Transactional
    String getFoo() { return getBar() }

    @Transactional(readOnly = true, propagation =
    Propagation.REQUIRES_NEW)
    String getBar() { return "bar" }
}
```

Now getBar() will always be readOnly



Metrics

Dropwizard metrics for meter, timer, histogram
Tuning for the 99%
Primarily use 1 minute rate, mean, and 99%



Leveraging caches

When to start adding caching?

Cache invalidation is hard to do well so be careful about pre optimizing

So you actually need to cache?

Client side vs Server side (mobile clients)

Distributed vs In-Memory caches (far vs near)

Near cache miss > Far cache miss -> RDS



Distributed caches (far caches)

Running in AWS ElastiCache

- Redis
- Memcached

Which one to choose after using both?

We actually still run both as they both fit a need.



In Memory caches (near caches)

Near cache as in-memory on the same box as the client

- Guava Cache (LoadingCache)
- ConcurrentHashMap





JVM Tuning with Groovy

Groovy may define classes at runtime
Every time you run a script, 1 (or more) new classes
are created and they stay in PermGen forever
`-XX:+CMSClassUnloadingEnabled`
Allows GC to sweep PermGen too and remove
classes no longer being used
Needed for Java 7, not needed in Java 8



Improving GC

-XX:+UseConcMarkSweepGC

-XX:+UseParNewGC

-XX:+ScavengeBeforeFullGC

-XX:+CMSScavengeBeforeRemark



GC Logging

- Xloggc:./gc.log
- XX:+PrintTenuringDistribution
- XX:+PrintGCDetails
- XX:+PrintGCDateStamps



Be aggressive with soft references

`-XX:SoftRefLRUPolicyMSPerMB=125`

Default value is 1000, or one second per MB

Lower number is cleared more aggressively



Explicit heap sizing

- Xms4G (Max heap size)
- Xmx4G (Min heap size)
- XX:MaxPermSize=2G (<= Java 7)
- XX:PermSize=2G (<= Java 7)
- Xmn1G (New gen size)
- XX:SurvivorRatio=8



Show Data

Memory (Java) ▾

View

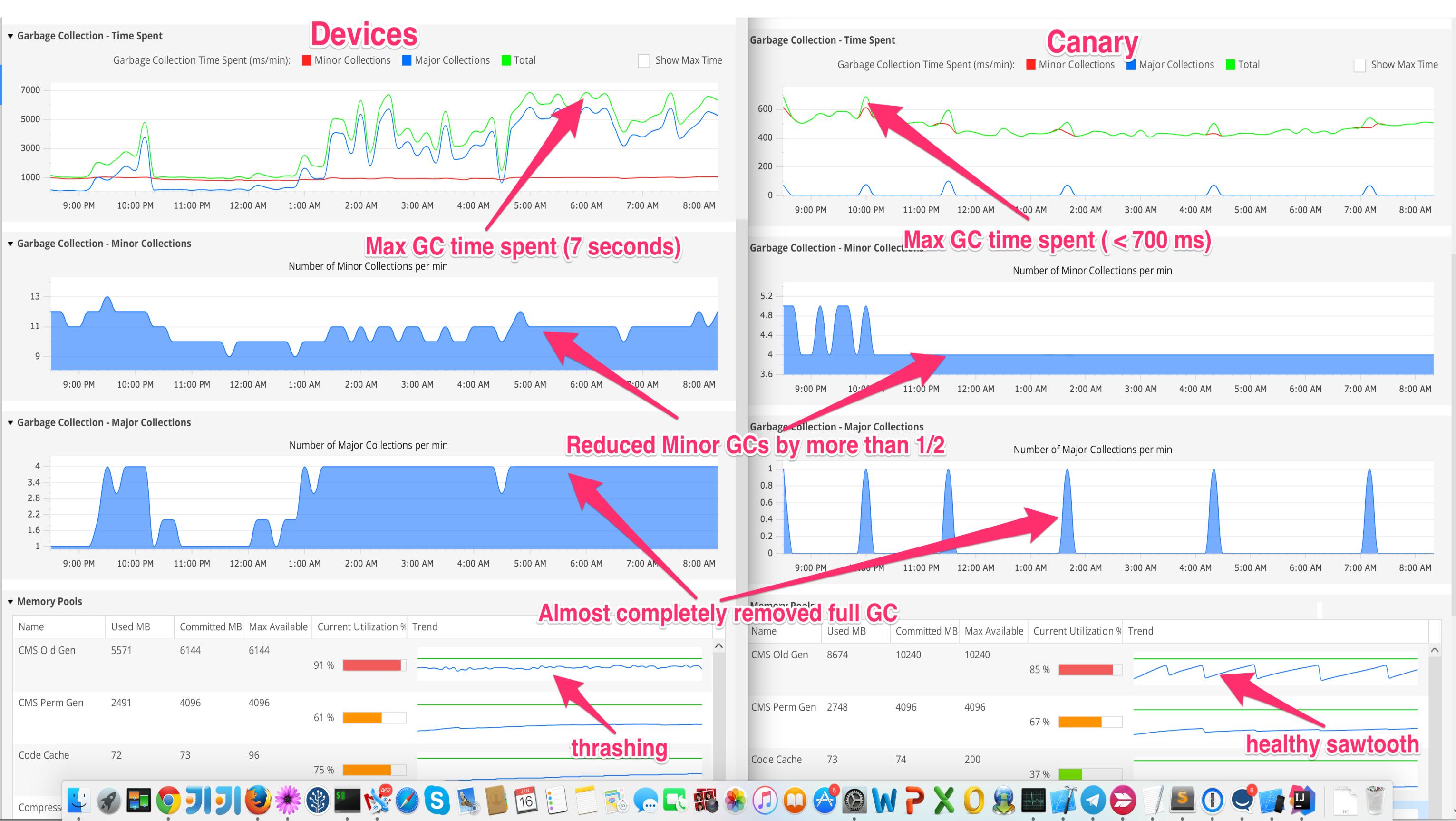


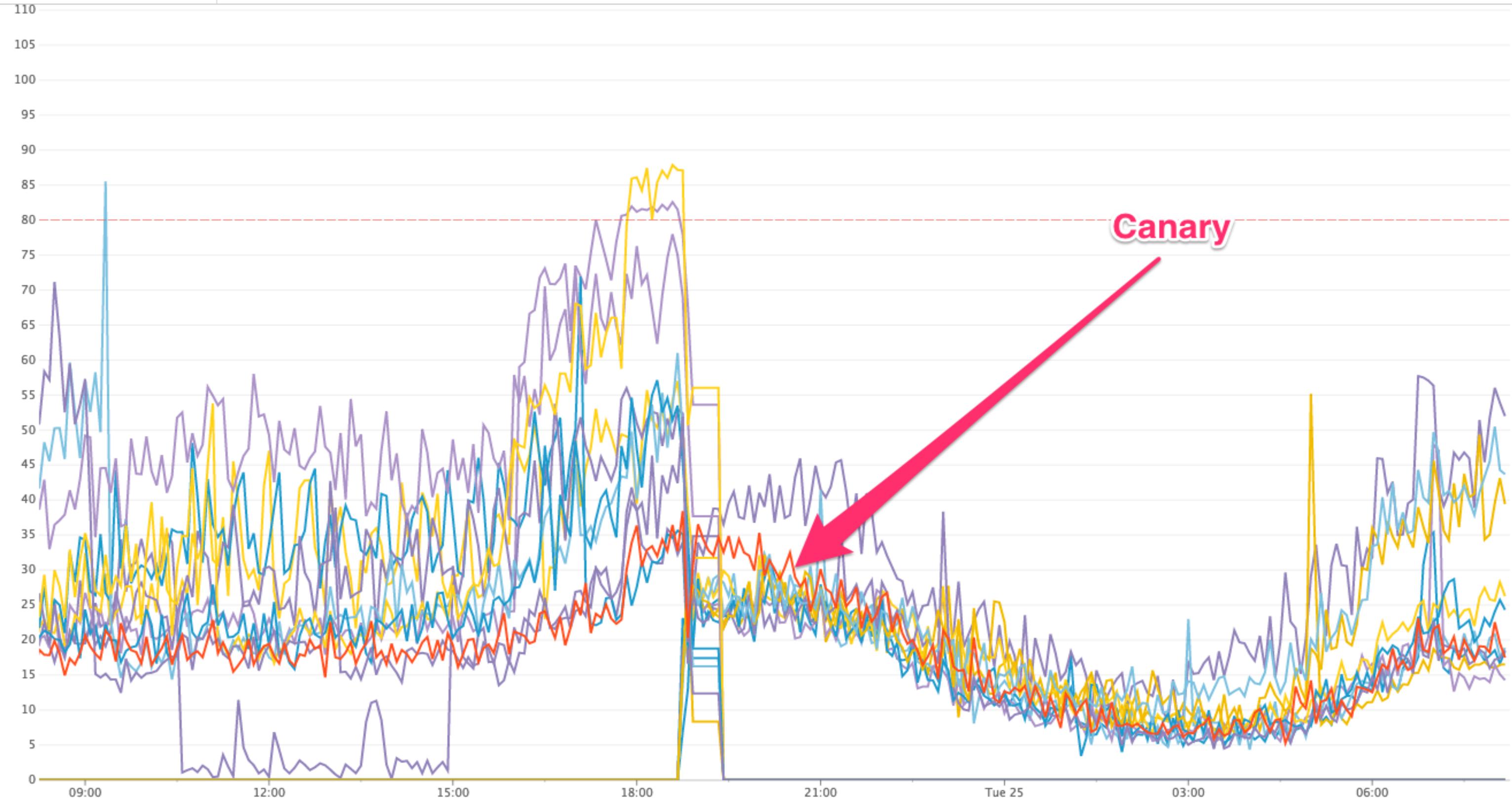
only 5 major GCs, next closest is more than double



Showing 10 of 68 Nodes

Name	Tier	JVM % Heap	Max Heap (MB)	JVM CPU Burnt (ms/min)	GC Time Spent (ms/min)	Major Collections	Major Col time per min...	Minor Collections	Minor Col time per mi...
ip-10-181-85-3	canary	SmartApps	<div style="width: 66.4%;"><div style="width: 100%;"> </div></div> 66.4%	13,909	134,302	491	<1/min, 5 total	10	3/min, 2.3k total
ip-10-67-165-84	SmartApps	<div style="width: 73.7%;"><div style="width: 100%;"> </div></div> 73.7%	10,035	144,655	808	<1/min, 11 total	17	6/min, 4.4k total	
ip-10-181-88-122	SmartApps	<div style="width: 74.4%;"><div style="width: 100%;"> </div></div> 74.4%	10,035	136,288	811	<1/min, 15 total	28	6/min, 4.3k total	
ip-10-238-28-185	SmartApps	<div style="width: 74.3%;"><div style="width: 100%;"> </div></div> 74.3%	10,035	140,459	829	<1/min, 13 total	25	6/min, 4.4k total	
ip-10-140-187-251	SmartApps	<div style="width: 73.8%;"><div style="width: 100%;"> </div></div> 73.8%	10,035	149,623	831	<1/min, 31 total	53	6/min, 4.3k total	
ip-10-137-148-130	SmartApps	<div style="width: 74.5%;"><div style="width: 100%;"> </div></div> 74.5%	10,035	147,981	864	<1/min, 19 total	34	6/min, 4.5k total	
ip-10-147-12-142	SmartApps	<div style="width: 74.4%;"><div style="width: 100%;"> </div></div> 74.4%	10,035	145,540	1,006	<1/min, 82 total	182	6/min, 4.4k total	
ip-10-146-225-205	SmartApps	<div style="width: 73.0%;"><div style="width: 100%;"> </div></div> 73.0%	10,035	151,041	1,099	<1/min, 161 total	279	6/min, 4.5k total	
ip-10-137-145-98	SmartApps	<div style="width: 73.1%;"><div style="width: 100%;"> </div></div> 73.1%	10,035	154,751	1,118	<1/min, 211 total	318	6/min, 4.4k total	
ip-10-236-243-80	SmartApps	<div style="width: 72.3%;"><div style="width: 100%;"> </div></div> 72.3%	10,035	156,505	1,638	1/min, 474 total	784	6/min, 4.6k total	







Rate Limiting

Effectively shed load to relieve backpressure

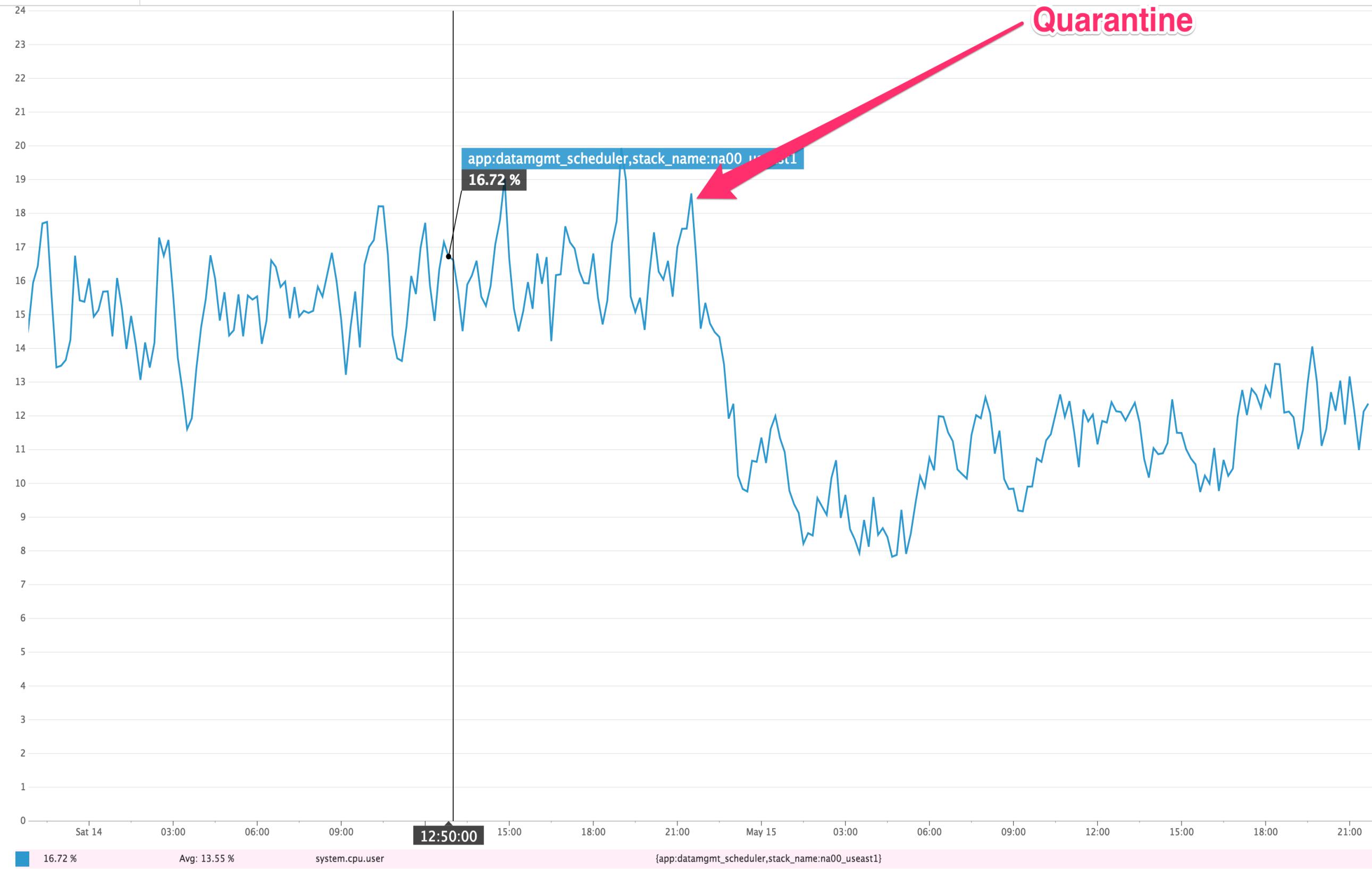
- Device execution
- SmartApp execution
- User API execution
- Etc...



Scheduler CPU

Show 2d May 13, 10:00PM – May 15, 10:00PM

◀ ▶ □

Quarantine



When you outgrow your plugins

The code you writing at the beginning of a project won't scale forever, so don't expect your plugins to

Quartz

For system jobs or crons that run a few times a day

Not running millions of schedules a day



Where do we go from here?

Microservices (business scalability)

Move more high churn MySql tables to C* or Aurora

Auto-Scaling based on various platform metrics

Automated blue/green deploys

More GC and performance tuning



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Questions?



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Ryan Applegate