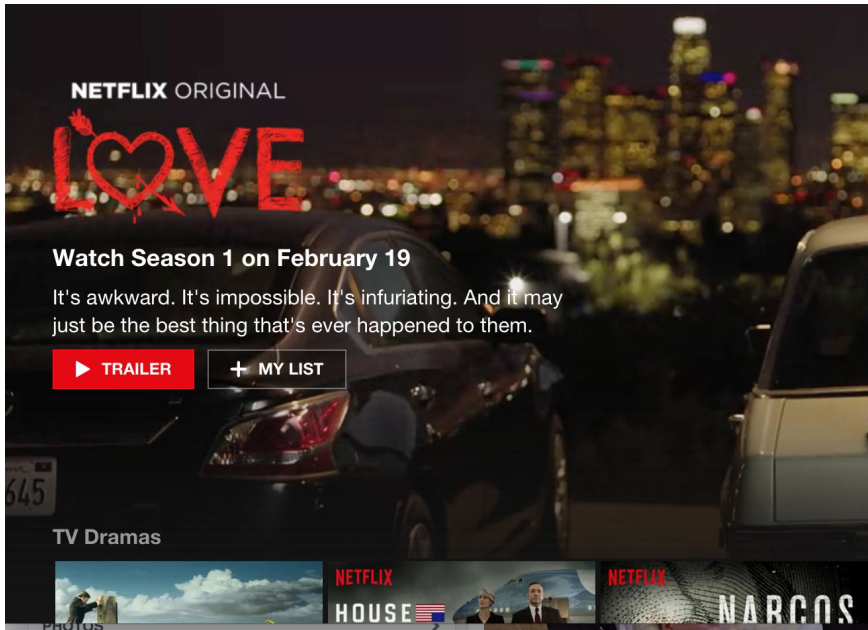
The Netflix API for a global service

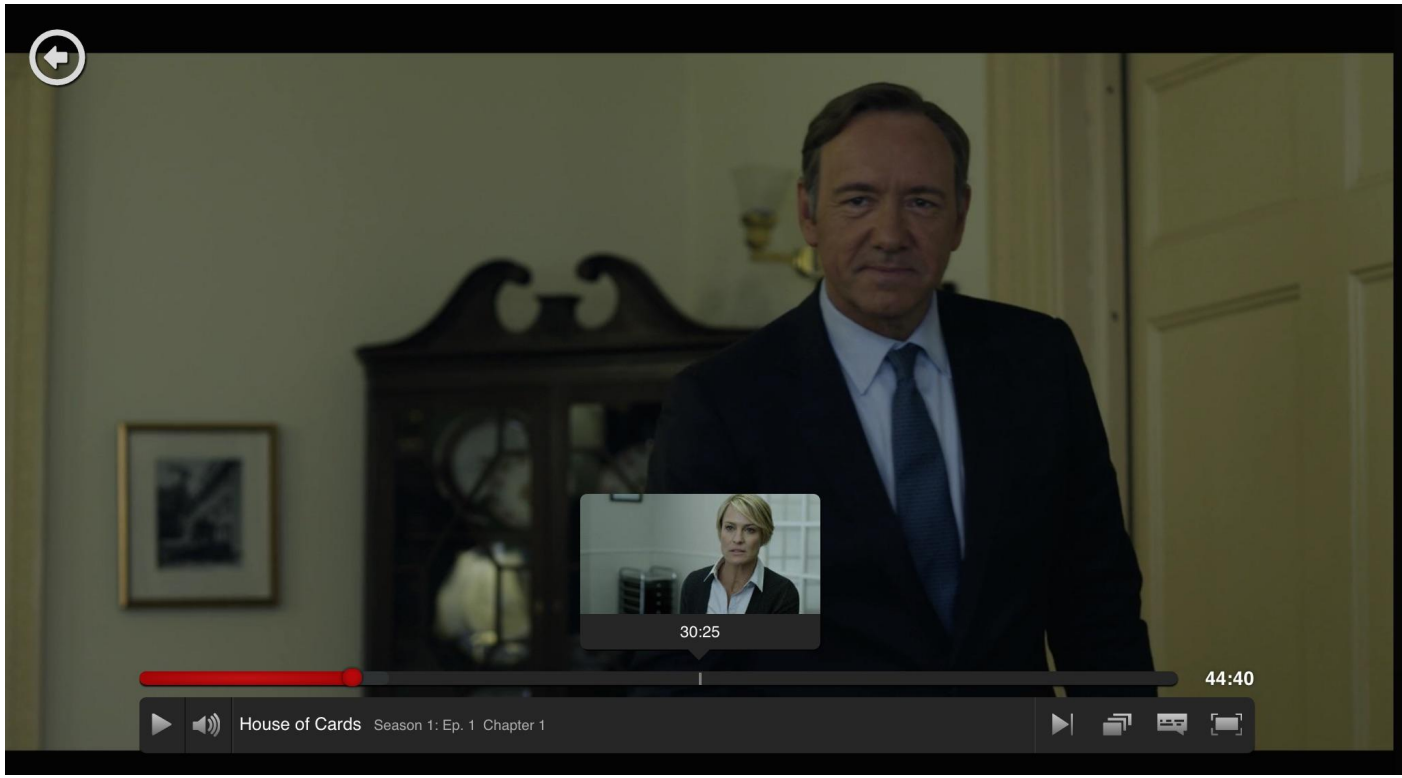
Katharina Probst
Engineering Manager, API
DevNexus, February 2016

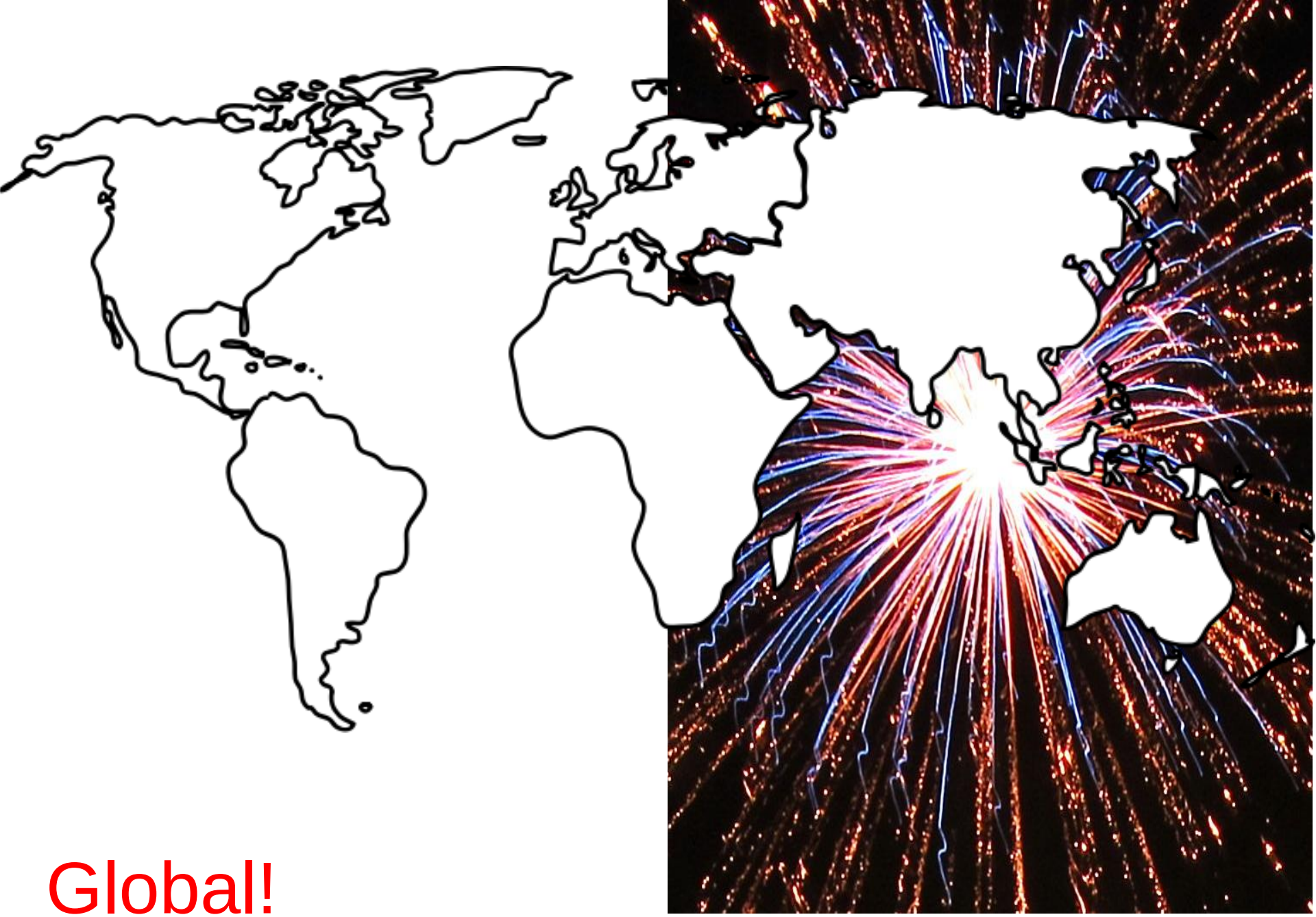
NETFLIX



What is Netflix?

Stream TV shows and movies anywhere, any time.





Global!

(except China and where we can't operate for legal reasons)

Netflix Originals

NETFLIX ORIGINAL
CHEF'S TABLE
★★★★★ 2015 TV-14 1 Season

A NETFLIX ORIGINAL FILM
BEASTS OF NO NATION
★★★★★ 2015 NR 2h 17m

Resume

1 of 137m

A brutal war took a boy's family. A mercenary commander takes his youth. In this war, the demons come for everyone.

⊕ MY LIST

Scale

- Peak downstream traffic in the US is 37%, upstream almost 7%.

	Upstream		Downstream		Aggregate	
Rank	Application	Share	Application	Share	Application	Share
1	BitTorrent	28.56%	Netflix	37.05%	Netflix	34.70%
2	Netflix	6.78%	YouTube	17.85%	YouTube	16.88%
3	HTTP	5.93%	HTTP	6.06%	HTTP	6.05%
4	Google Cloud	5.30%	Amazon Video	3.11%	BitTorrent	4.35%
5	YouTube	5.21%	iTunes	2.79%	Amazon Video	2.94%
6	SSL - OTHER	5.10%	BitTorrent	2.67%	iTunes	2.62%
7	iCloud	3.08%	Hulu	2.58%	Facebook	2.51%
8	FaceTime	2.55%	Facebook	2.53%	Hulu	2.48%
9	Facebook	2.25%	MPEG - OTHER	2.30%	MPEG	2.16%
10	Dropbox	1.18%	SSL - OTHER	1.73%	SSL - OTHER	1.99%
		65.95%		78.69%		76.68%

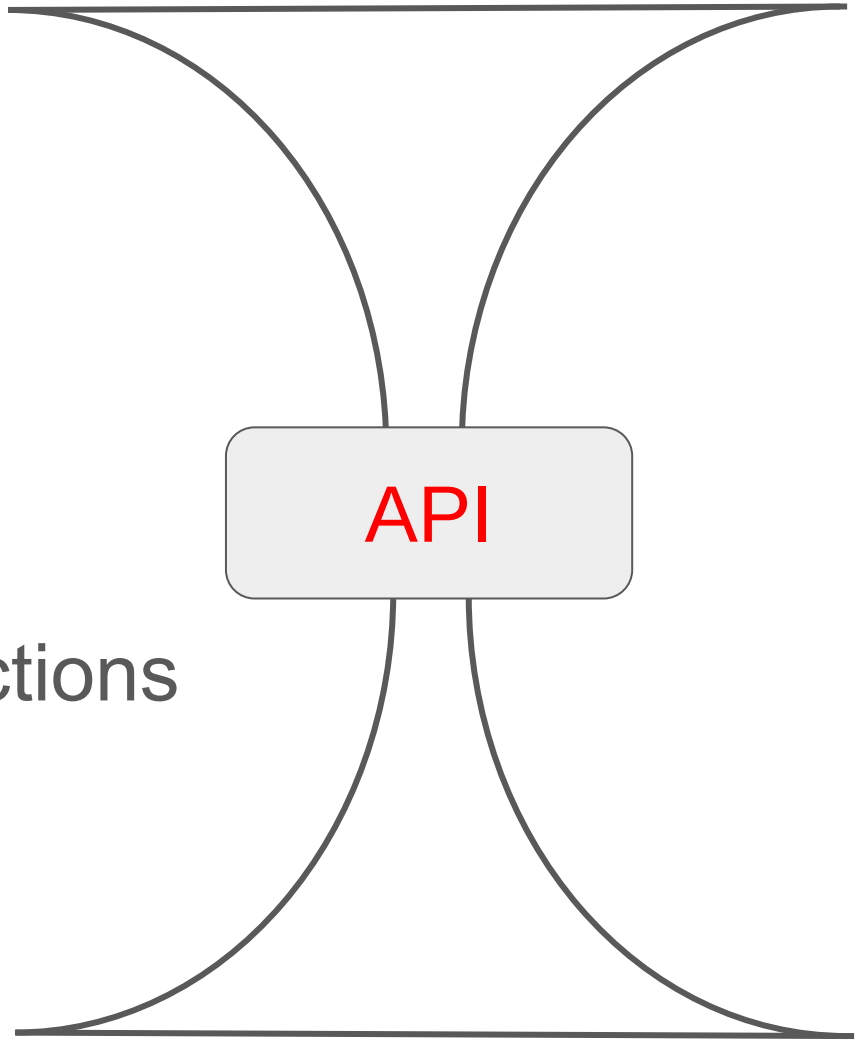
sandvine

Source: http://www.sandvine.com/news/global_broadband_trends.asp

- 75 Million subscribers worldwide and growing

Netflix API

- Architecture
- Resiliency
- Developer velocity
- Tooling and DevOps
- Current and future directions



Netflix API

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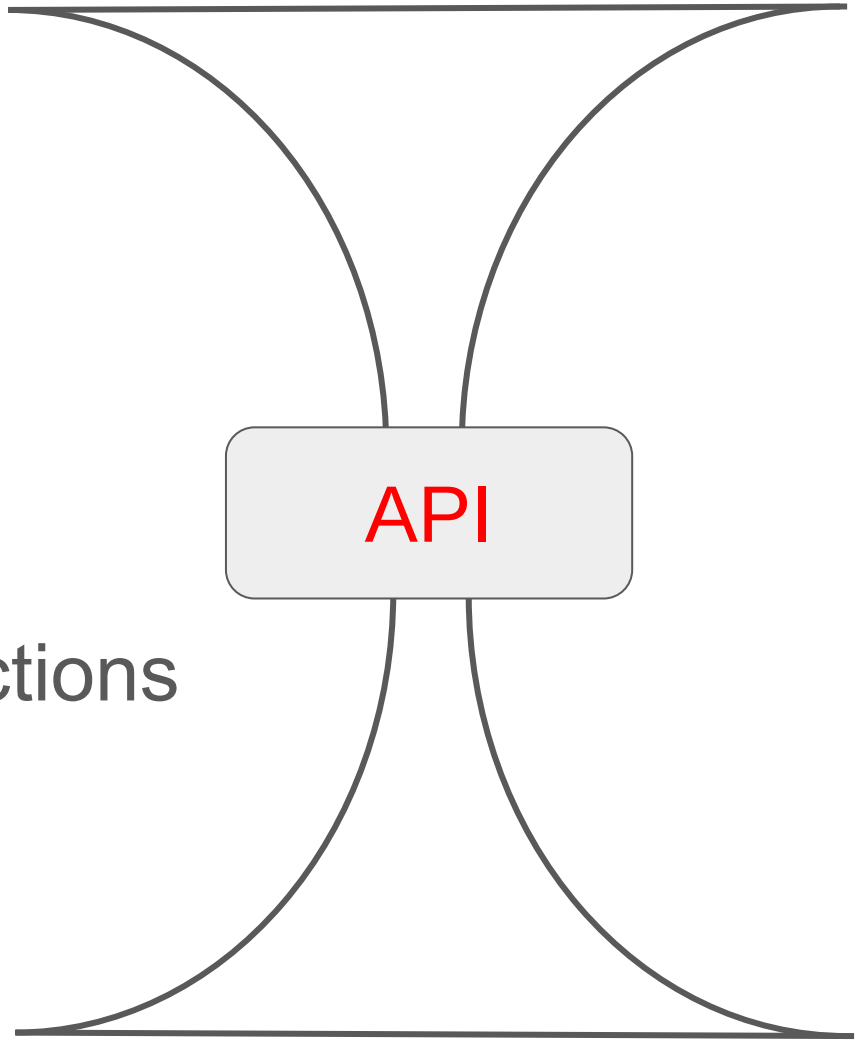


ELB

Zuul
(gateway)

API

Personali-
zation
Engine

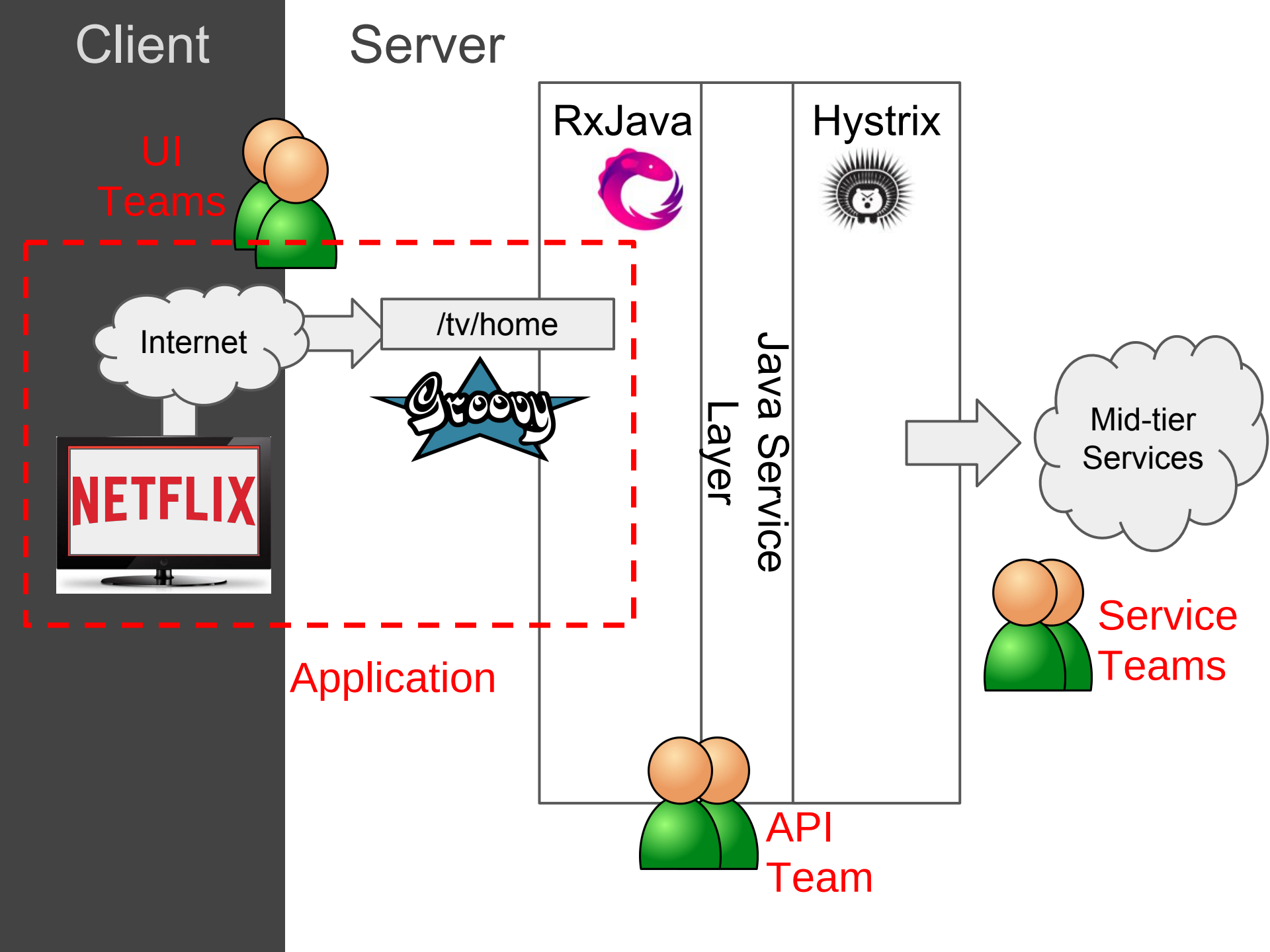
User
Info

. . .

Ratings

Similar
Movies

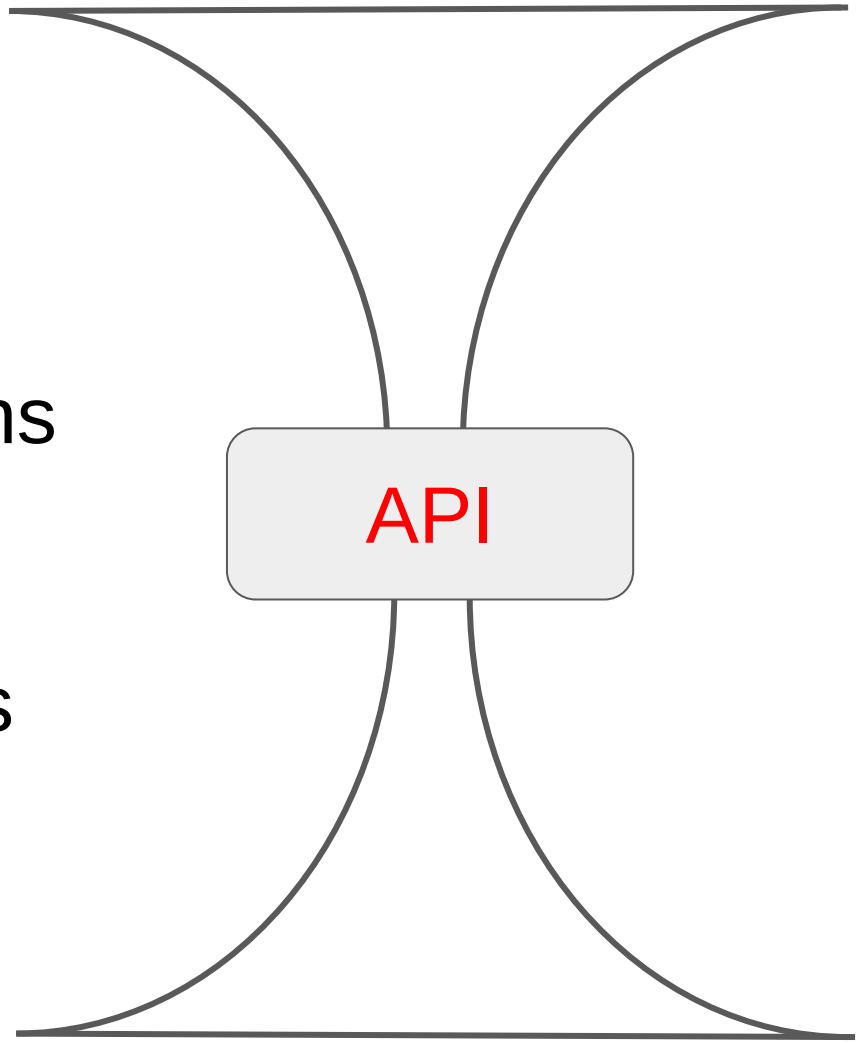
A/B Test
Engine


Client
Server
RxJava
Hystrix
UI
Teams
Internet
/tv/home
Groovy
NETFLIX
Java Service
Layer
Mid-tier
Services
Application
Service
Teams
API
Team

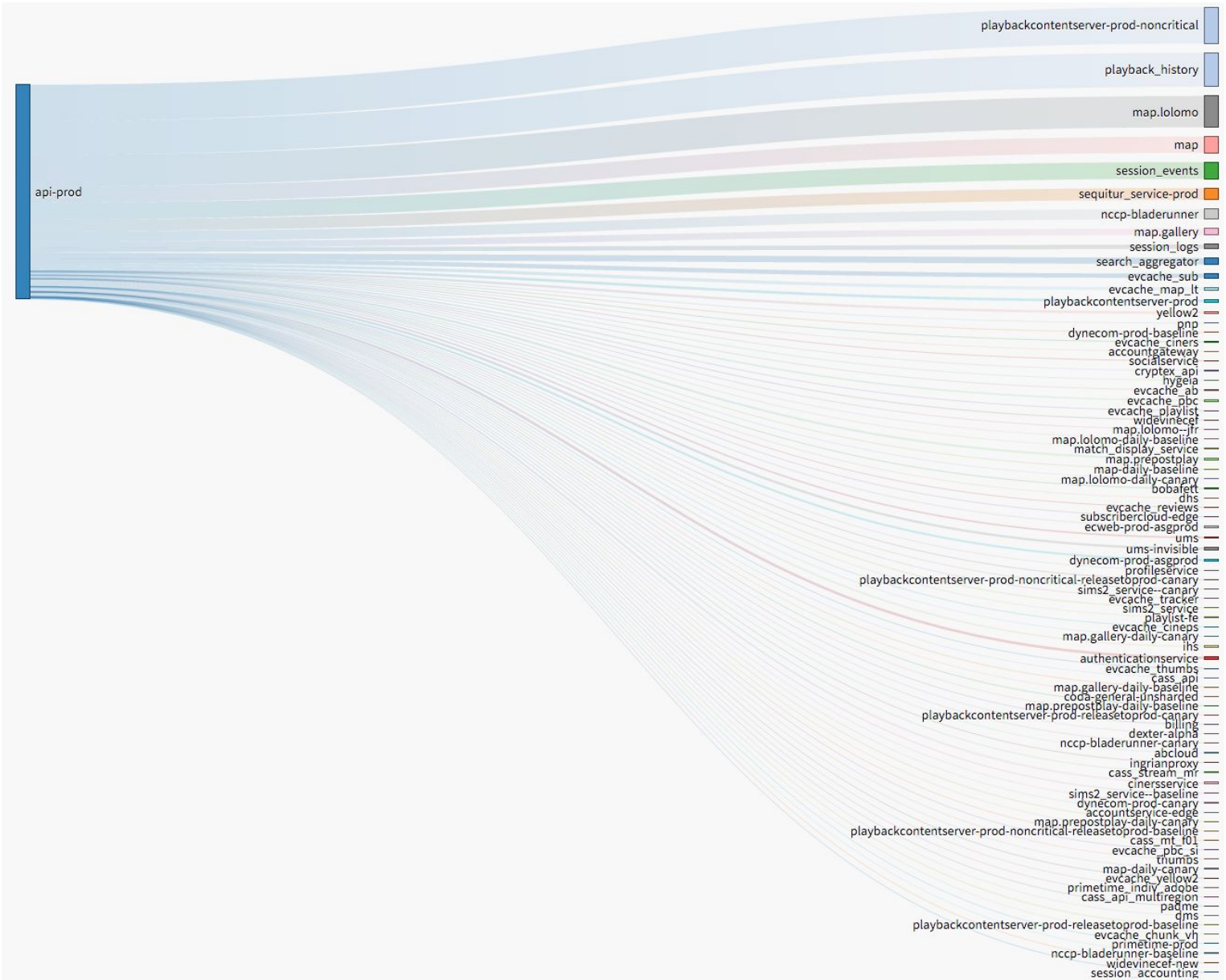
What is the API used for?

Examples:

- Discovery
  - Recommendations
  - Move metadata
  - Ratings
- Sign-up and Profiles
- Playback
  - Bookmarks
  - DRM
- A/B testing



Direct dependencies on other services



Netflix API

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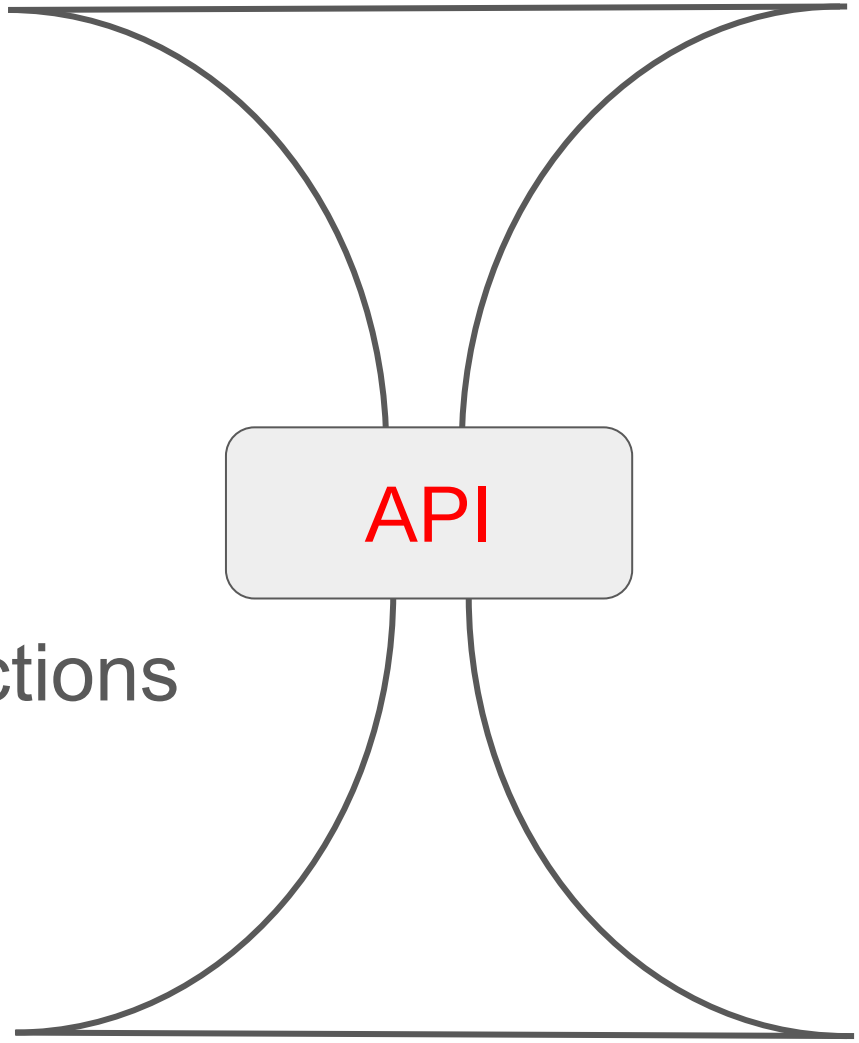


Hystrix Primer

- Protection from and control over latency and failure from dependencies
- Stop cascading failures in a complex distributed system
- Fall back and gracefully degrade
- Fail fast and rapidly recover

https://github.com/Netflix/Hystrix

API

Personali-zation Engine

User Info

. . . .

Ratings

Similar Movies

A/B Test Engine

Don’t let this happen.

Pers ali-
z
E

User Info

. . . .

Ratings

Similar Movies

A/B Test Engine

Don’t let this happen.

Perso-nali-z- E-

User Info

. . . .

Ratings

Similar Movies

A/B Test Engine

Do this instead.

API

Fallback Response

Personali-z… E…

User Info

. . . .

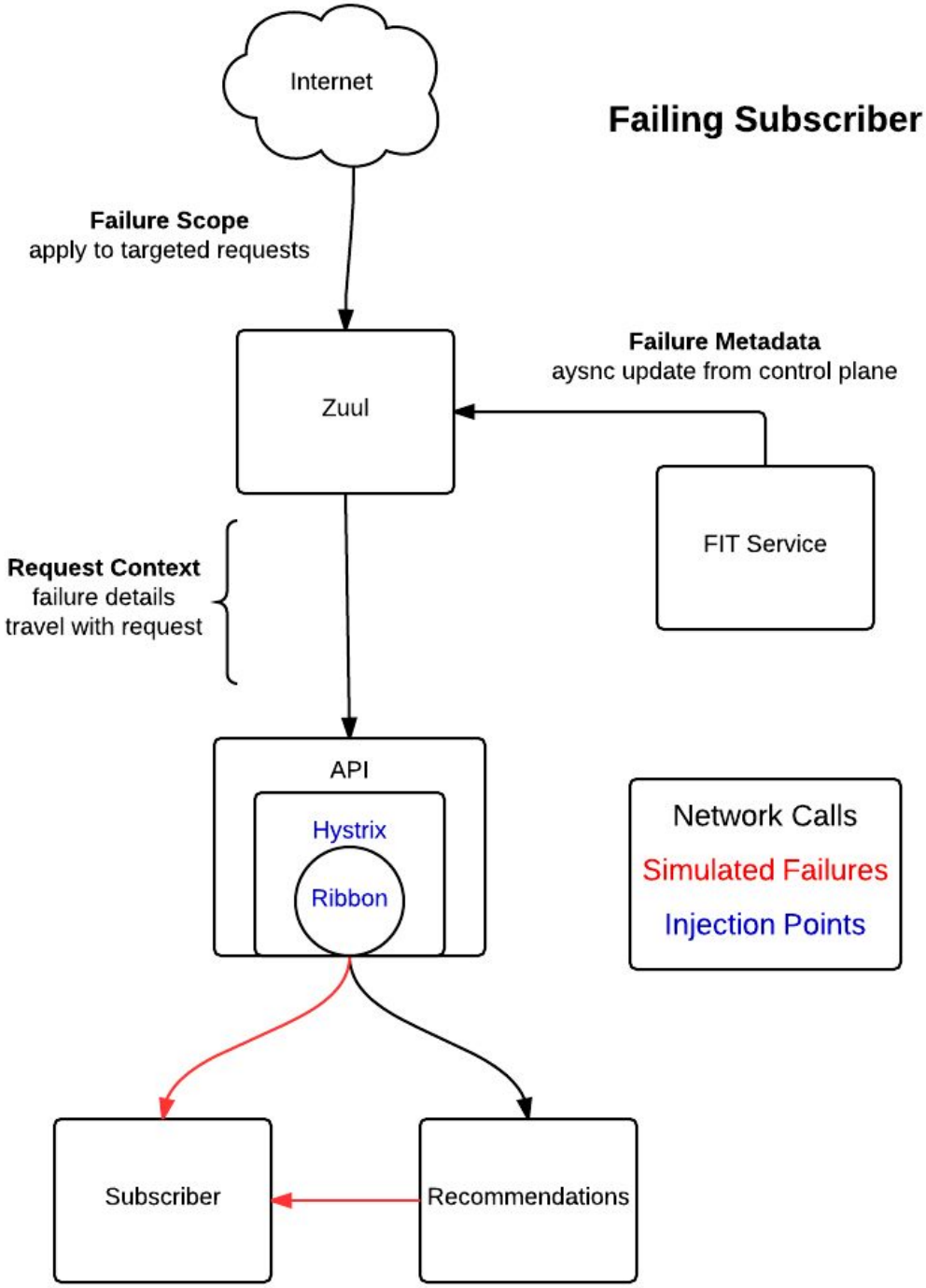
Ratings

Similar Movies

A/B Test Engine

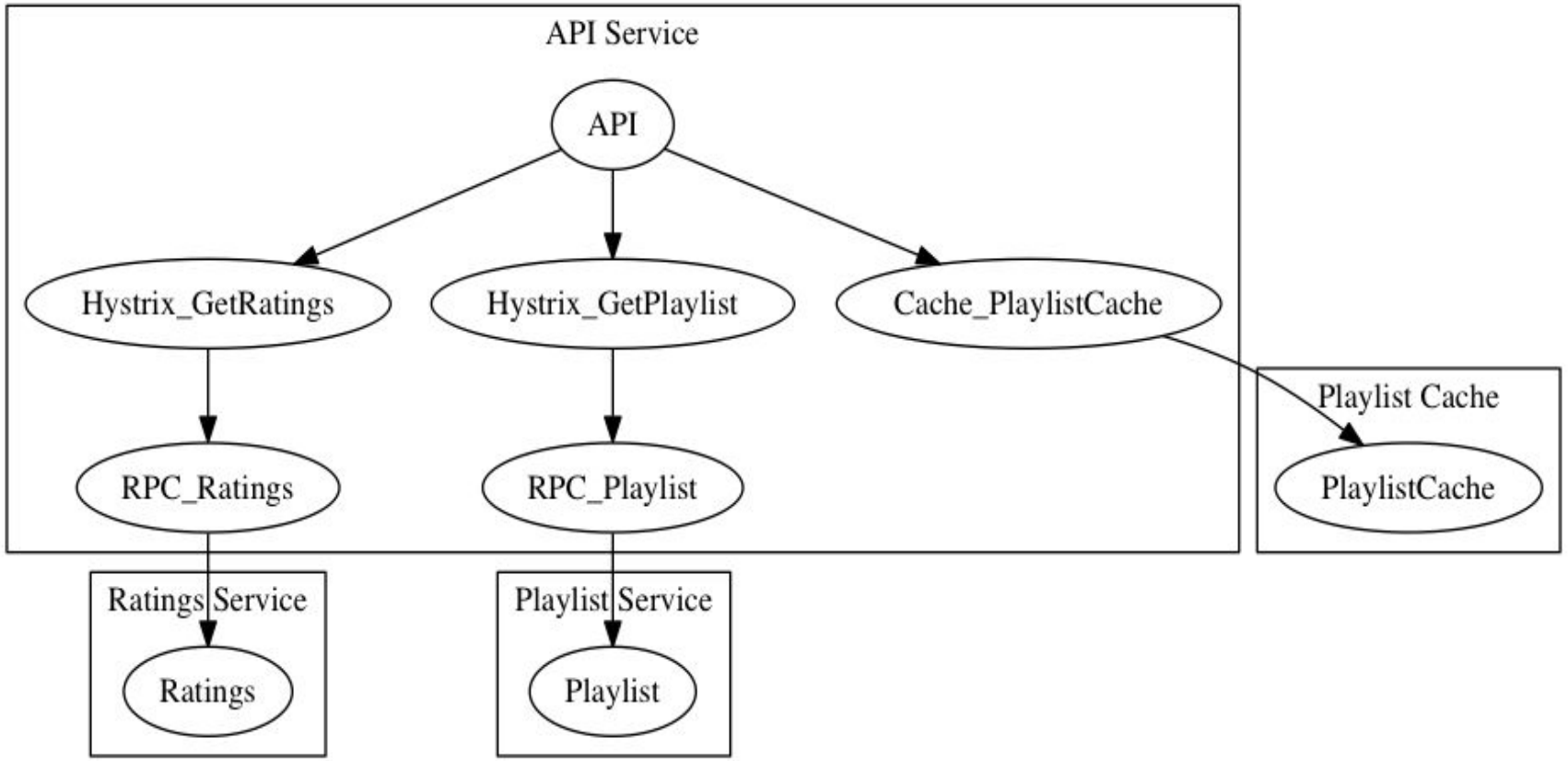
Failure Injection Testing (FIT)

Goal: Study how the system behaves when a failures occur (e.g., backend service unreachable).



More automated failure testing

Goal: Find groups of service calls that are needed for success.

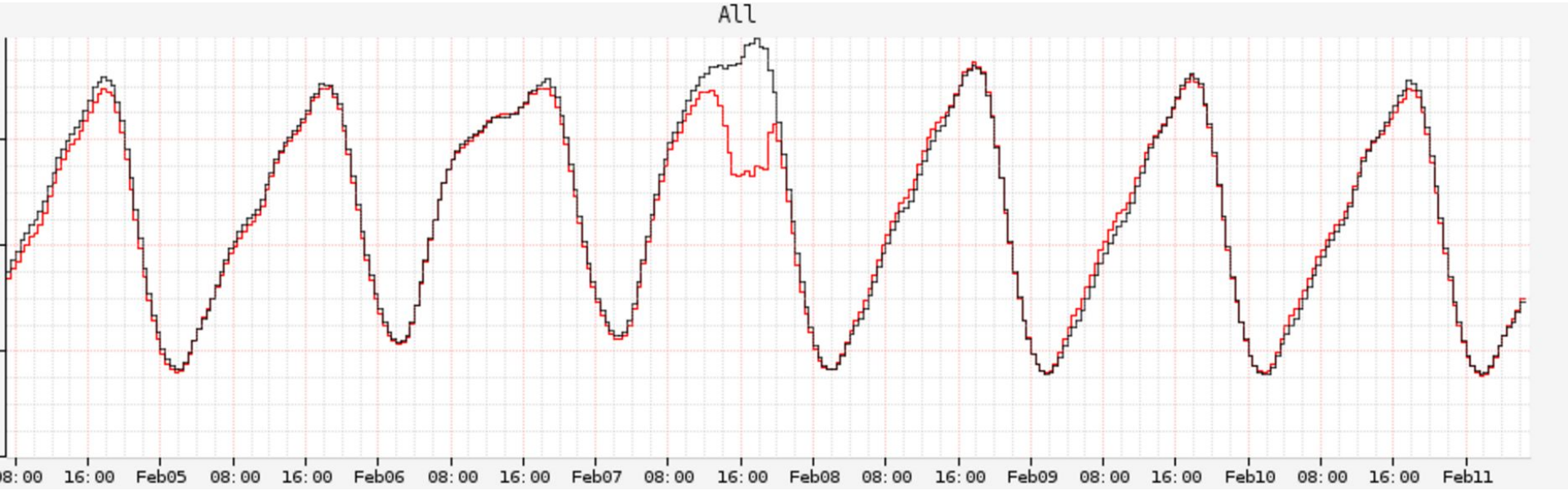


http://techblog.netflix.com/2016/01/automated-failure-testing.html

Autoscaling & Capacity Management

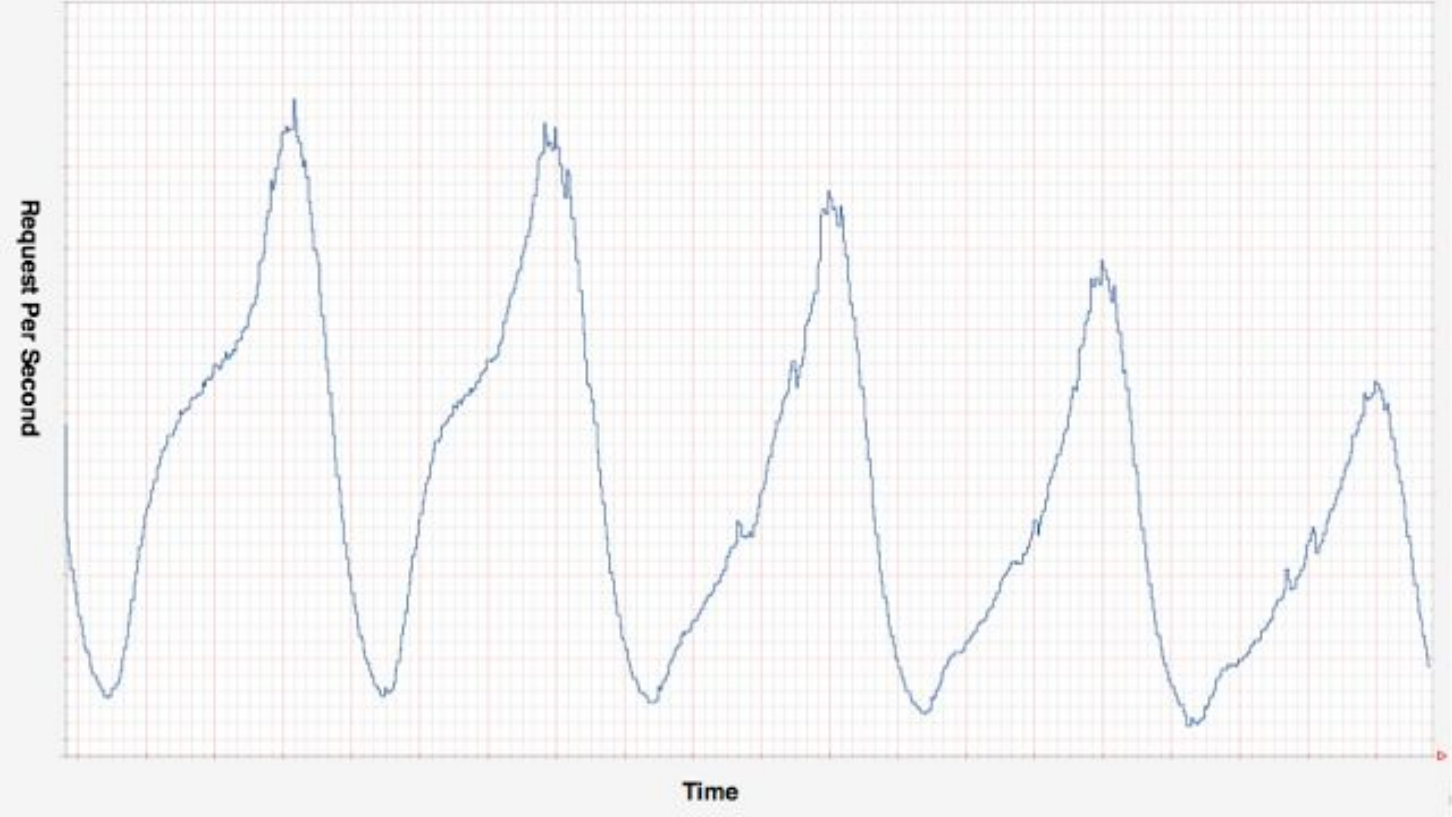
http://nflx.it/1LvqLUi

Autoscaling & Capacity Management

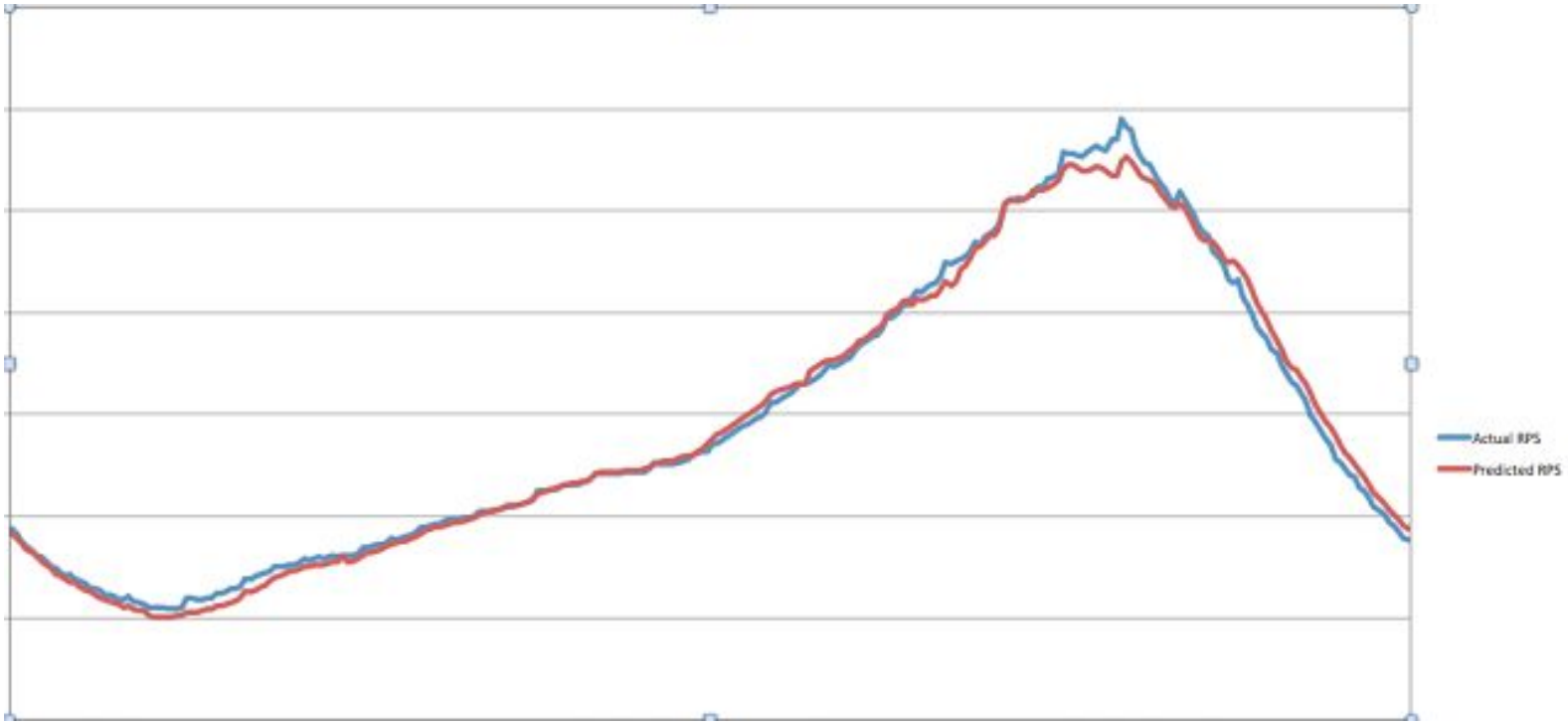


- Red: traffic for current week (x-axis)
- Black: traffic for previous week for comparison
- What happened on February 7? Superbowl!

AWS Controls Reactive, does not scale up fast enough



Fine-grained Control with Scryer Complements AWS Controls



- ❏ Faster scale-up, improved cost
- ❏ Use reactive policy for organic scale down

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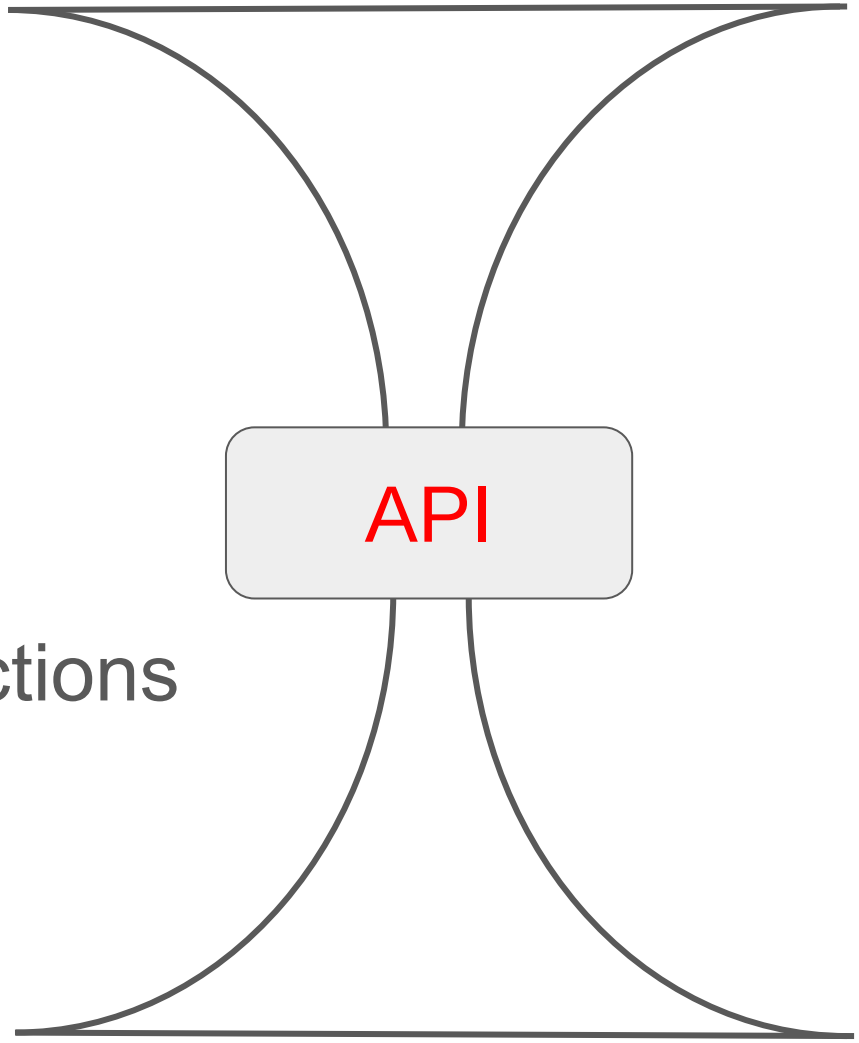
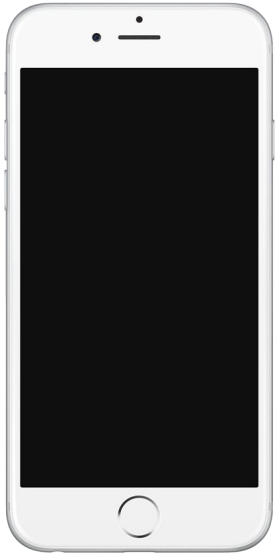


Lots of devices, lots of variety

Different interaction models



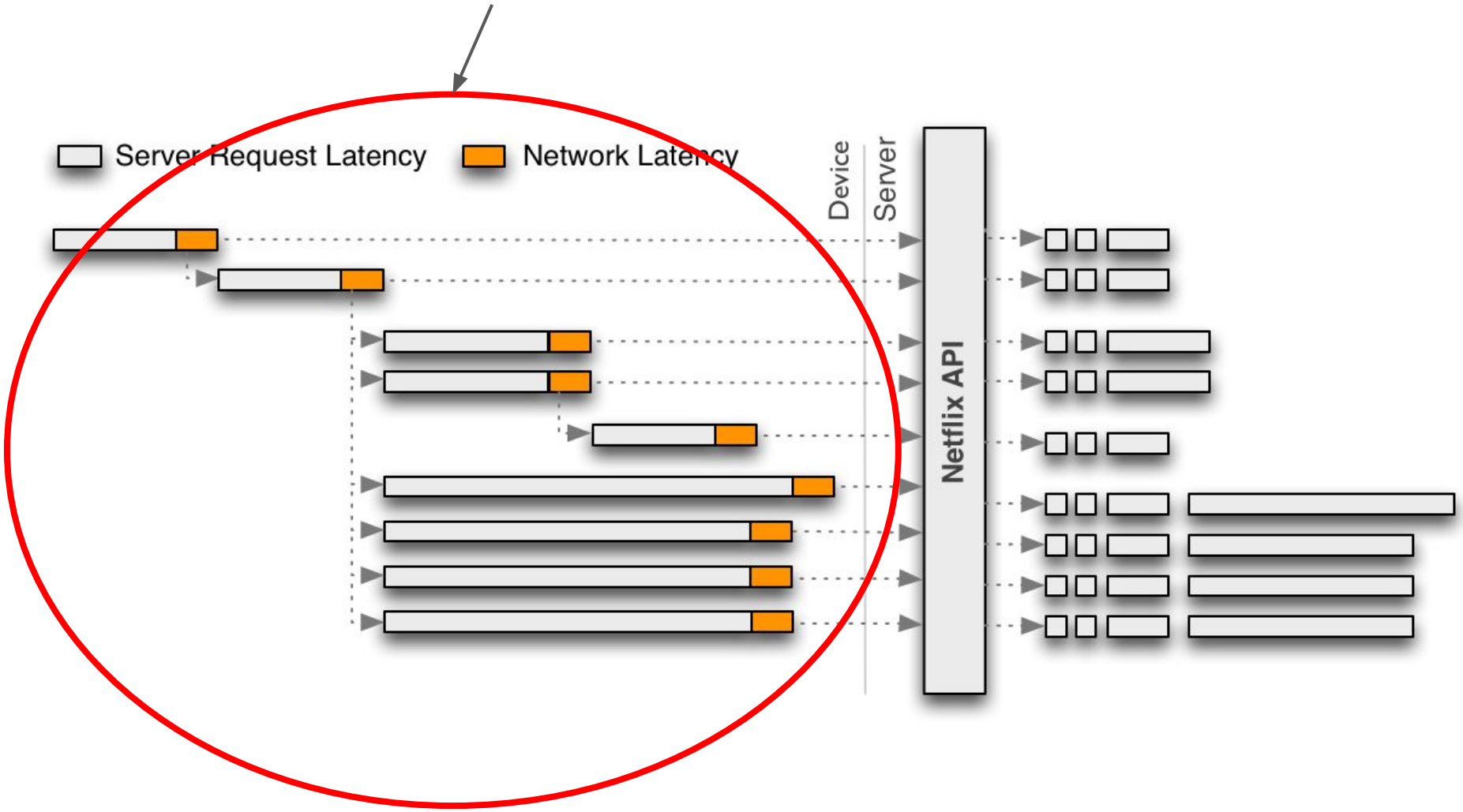
And just to make things a little more interesting….

- ❑ A/B tests
- ❑ profiles
- ❑ localization

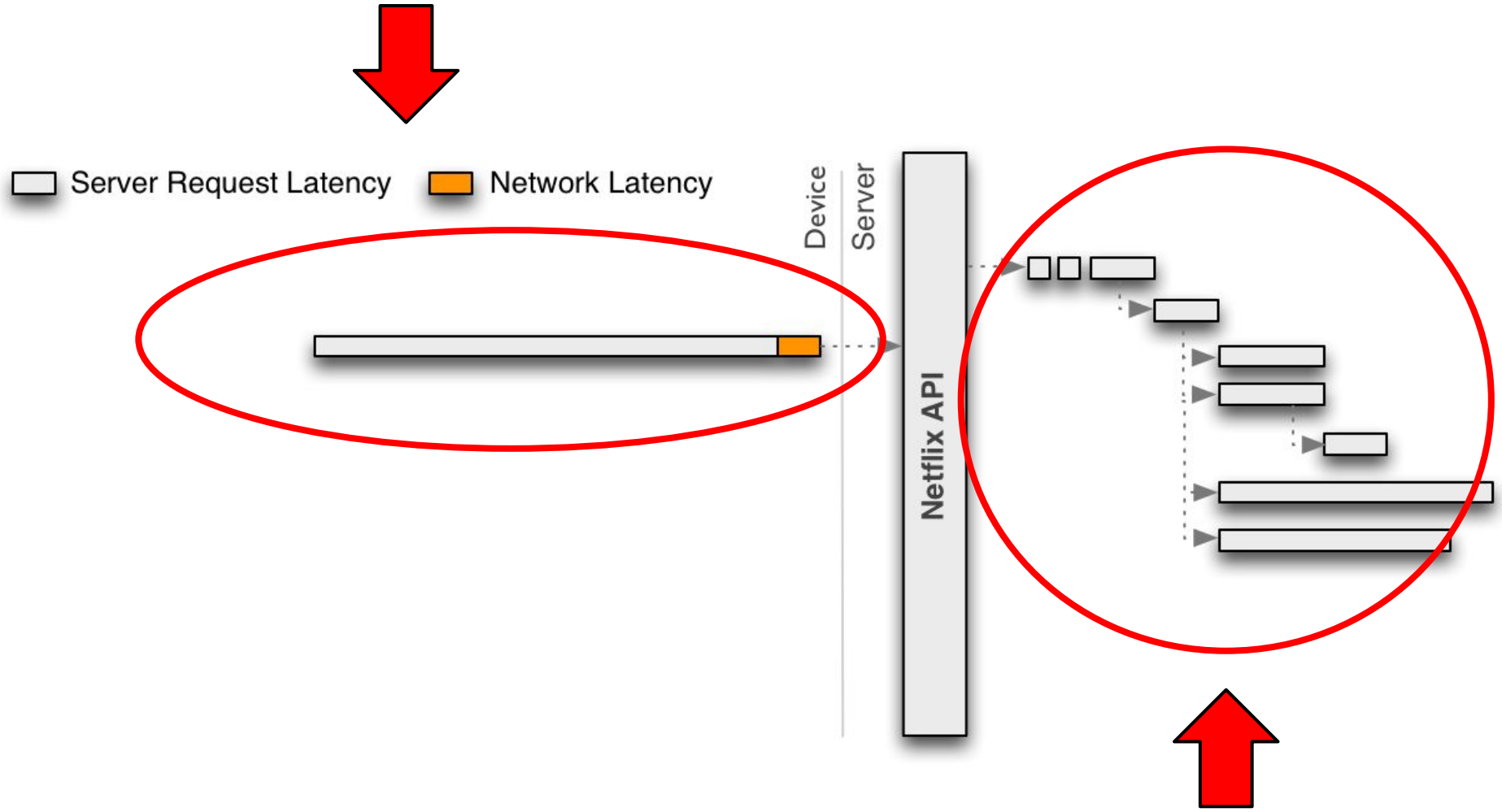
Add server-side scripting capability

- Reduce network chattiness
- Support device optimizations
- Enable faster development for internal users

Discrete HTTP requests pay network tax repeatedly



Single, optimized request; pay network tax once



Client data assembly logic pushed to server

Remote API

```
GET
/users/{user_id}/lists
```

Local Method

```
getLists(userId)
```

Impact on velocity and collaboration

- UI (script) changes can happen independently
- Script changes can be pushed to running servers, so decoupled from API push schedule
- Decoupling leads to greater developer velocity

Netflix API

- Architecture
- Resiliency
- Developer velocity
- **Tooling and DevOps**
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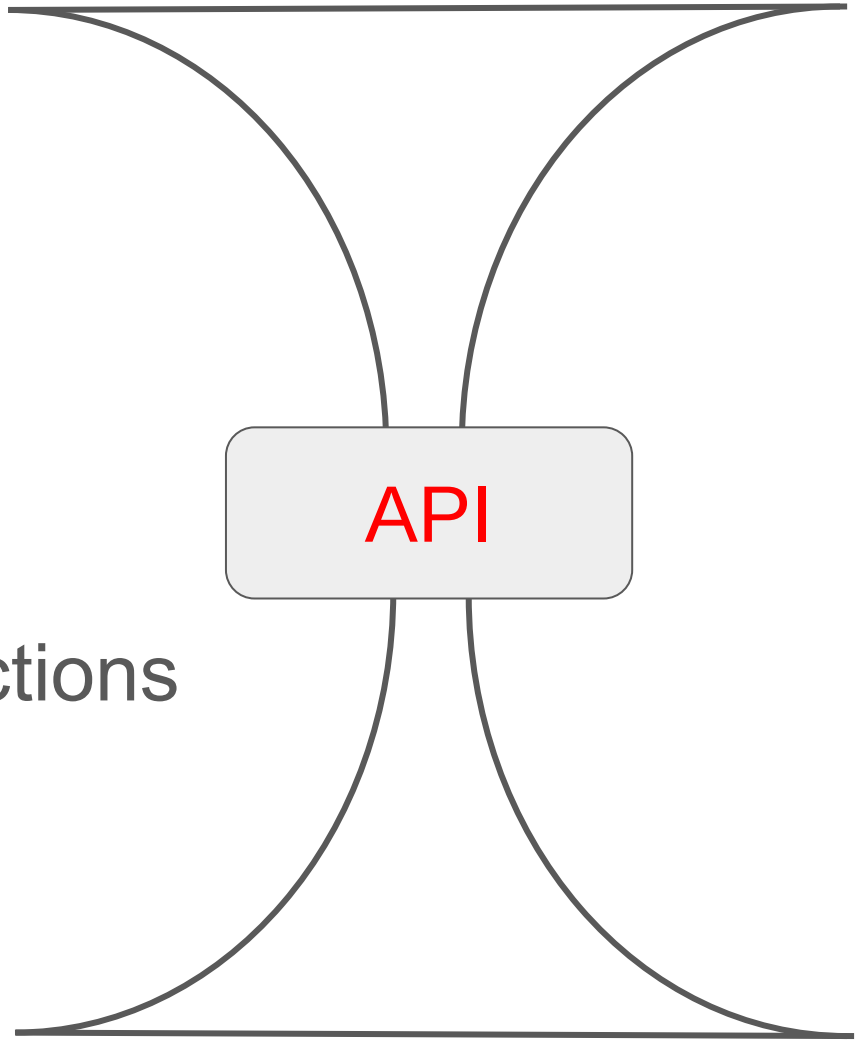
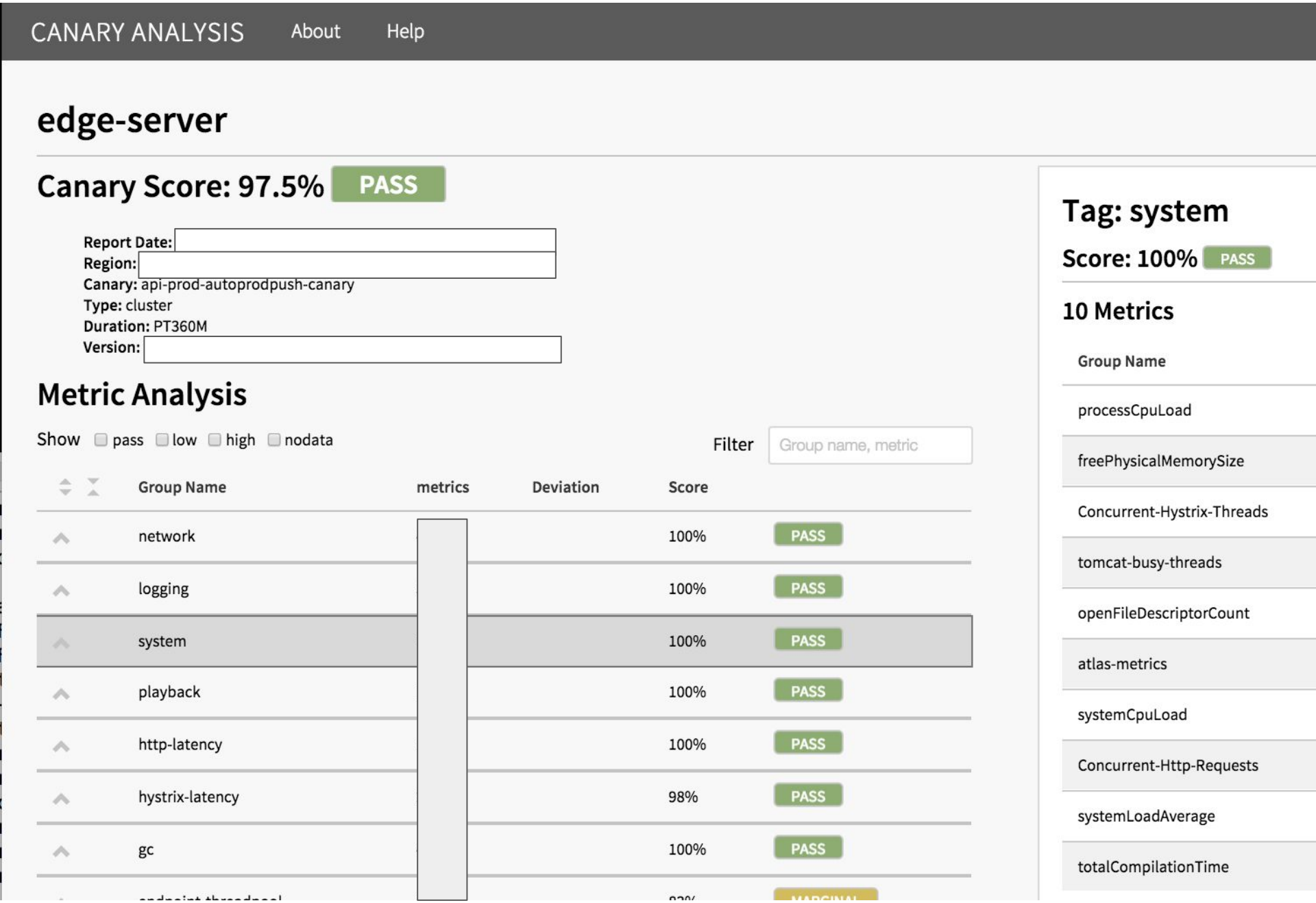


Run 1% of your traffic on the new code and see how it does

So you've run a canary. Now what?

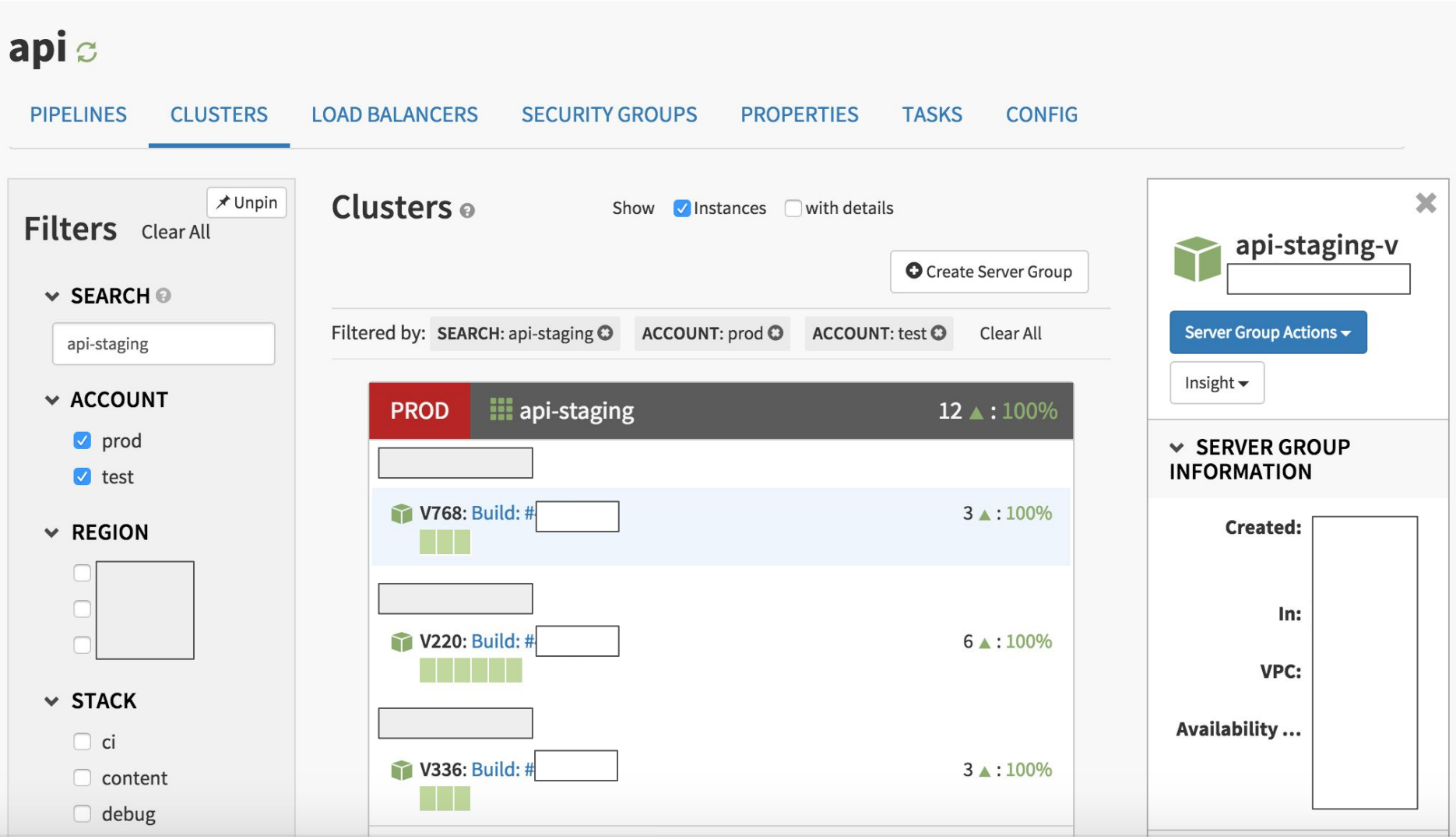
- Errors: 2xx, 4xx, 5xx
- latency
- network
- busy threads
- load, memory consumption
- ...


CANARY ANALYSIS
About
Help
edge-server
Canary Score: 97.5%
PASS
Report Date:
Region:
Canary: api-prod-autoprodpush-canary
Type: cluster
Duration: PT360M
Version:
Metric Analysis
Show
pass
low
high
nodata
Filter
Group name, metric
Group Name
metrics
Deviation
Score
network
100%
PASS
logging
100%
PASS
system
100%
PASS
playback
100%
PASS
http-latency
100%
PASS
hystrix-latency
98%
PASS
gc
100%
PASS
Tag: system
Score: 100%
PASS
10 Metrics
Group Name
processCpuLoad
freePhysicalMemorySize
Concurrent-Hystrix-Threads
tomcat-busy-threads
openFileDescriptorCount
atlas-metrics
systemCpuLoad
Concurrent-Http-Requests
systemLoadAverage
totalCompilationTime

Successful canary

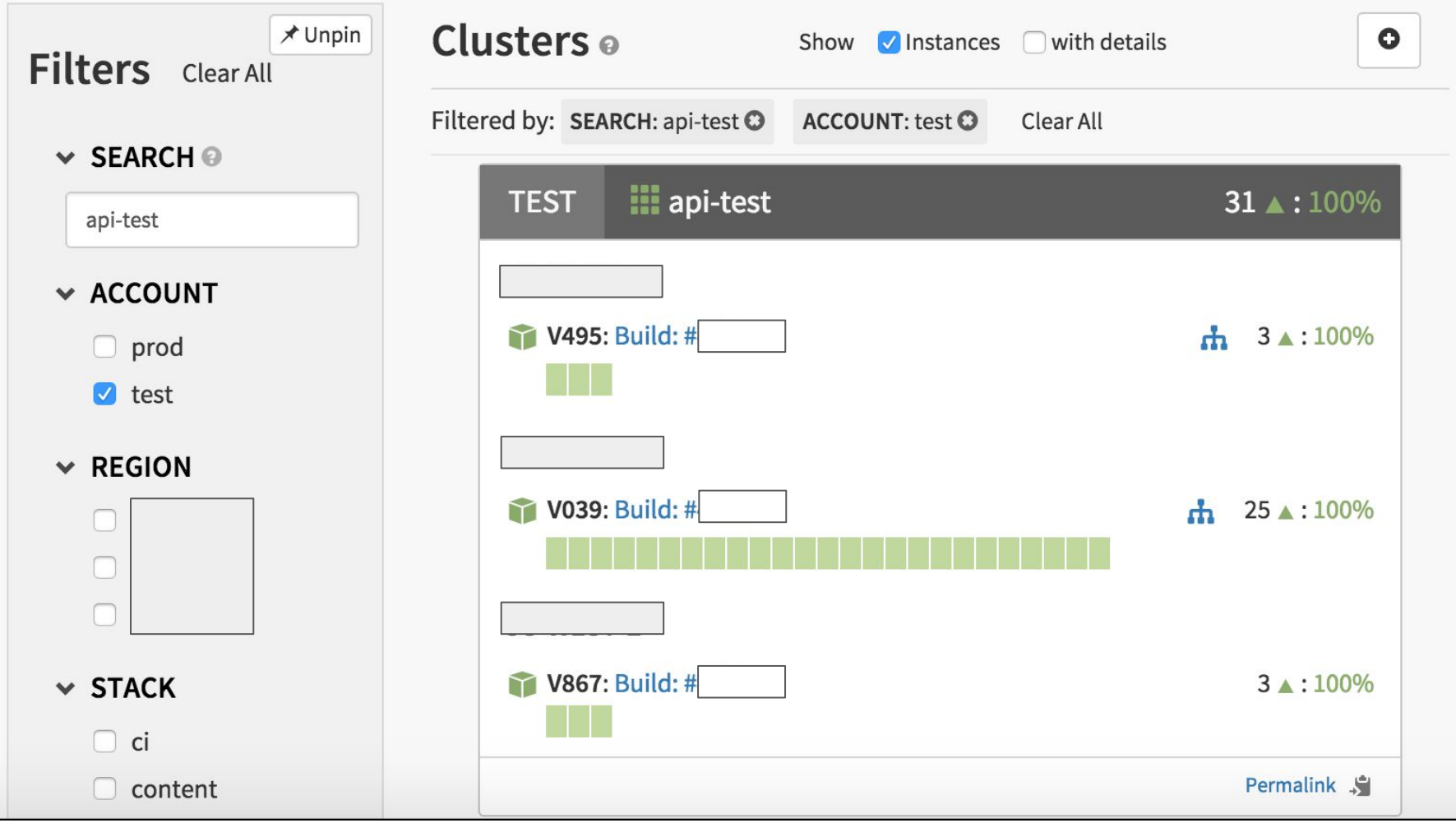
red/black push

Continuous Delivery with Spinnaker



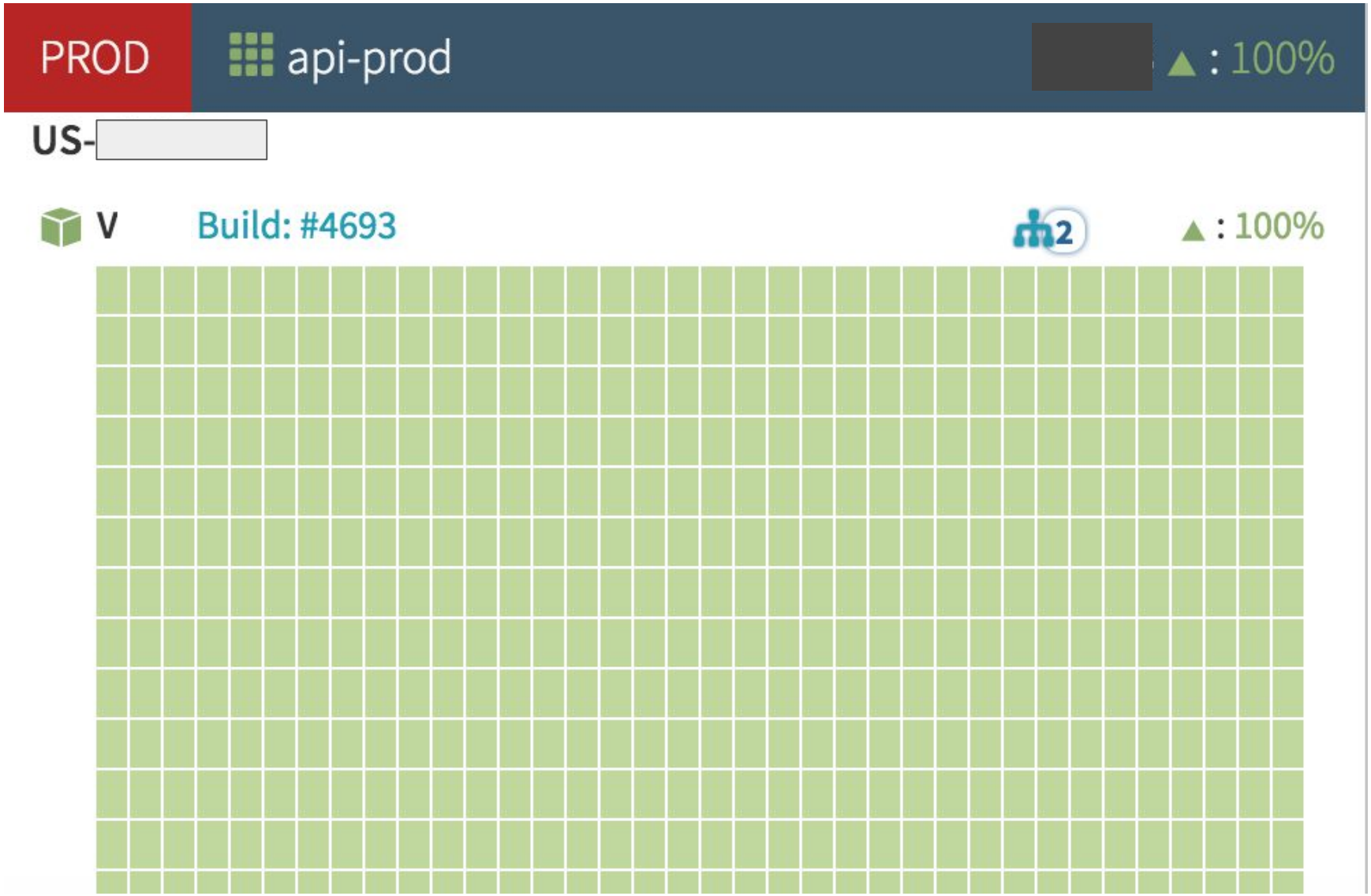
http://techblog.netflix.com/2015/09/moving-from-asgard-to-spinnaker.html

Quickly see status of all clusters



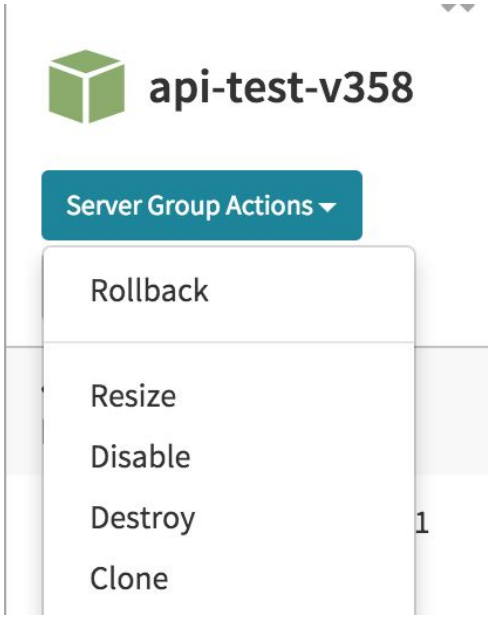
http://techblog.netflix.com/2015/09/moving-from-asgard-to-spinnaker.html

Prod is a little different….

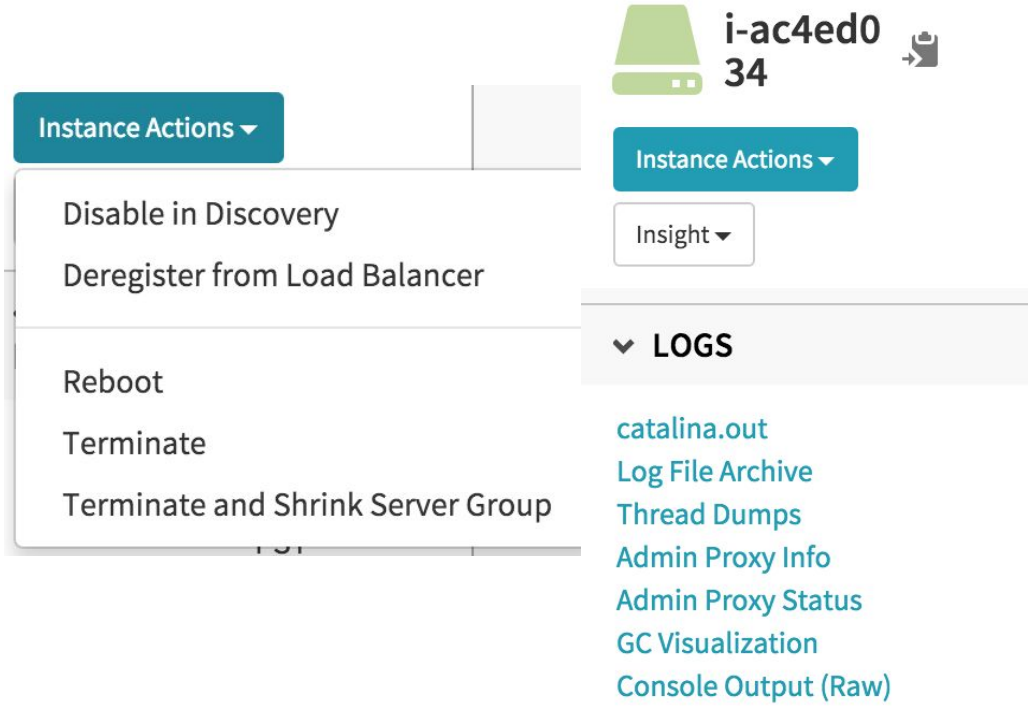


The things you can do

… with server groups



… with instances



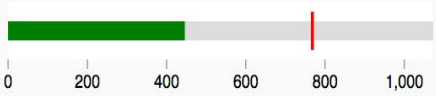
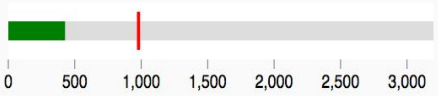
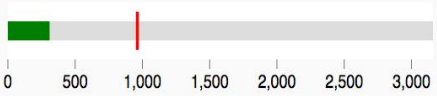
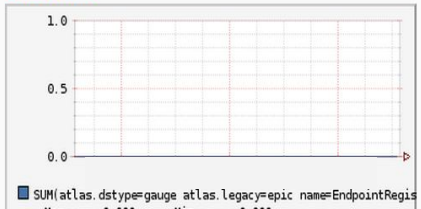
Script Management

EdgeCenter | ENDPOINTS | SERVICE LAYER | DELIVERY | ENVIRONMENTS | DEPLO

ENDPOINTS
- Overview
- Manage
- Health
- Activity

RESOURCES
- .Next SDK
- .Next Javadoc
- .Next User Guide
- .Next REPL (PROD)
- Deployments
- Environments

Endpoints > Overview

Env	PROD	STAGING	INT
Endpoints Usage			
Active Endpoints, Total Endpoints, Active Limit			
Recent Activity	2014-06-20 21:42:13 PDT /mobile/s Revision 9 activated.	2014-06-20 17:32:26 PDT /apps/ Revision 22 activated.	2014-06-20 21:42:13 PDT /mobile/ Revision 9 activated.
Show/Hide	2014-06-20 21:42:03 PDT /mobile/staging Revision 12 activated.	2014-06-20 17:04:19 PDT /tvui/lgml- Was deactivated.	2014-06-20 21:42:03 PDT /mobile Revision 12 activated.
	/android/samurai/config Revision 55 activated.	/ecapi/accou Revision 4 activated.	/android/ Revision 55 activated.
	2014-06-20 15:16:56 PDT /mobile/ Revision 24 activated.	2014-06-20 15:55:03 PDT /ecapi/acc Revision 10 activated.	2014-06-20 15:16:56 PDT /mobile Revision 24 activated.
	/mobile/t Revision 26 activated.	/ecapi/acc Revision 11 activated.	/mobile Revision 26 activated.
Compilation Failures	Atlas Link 	Atlas Link 	Atlas Link 

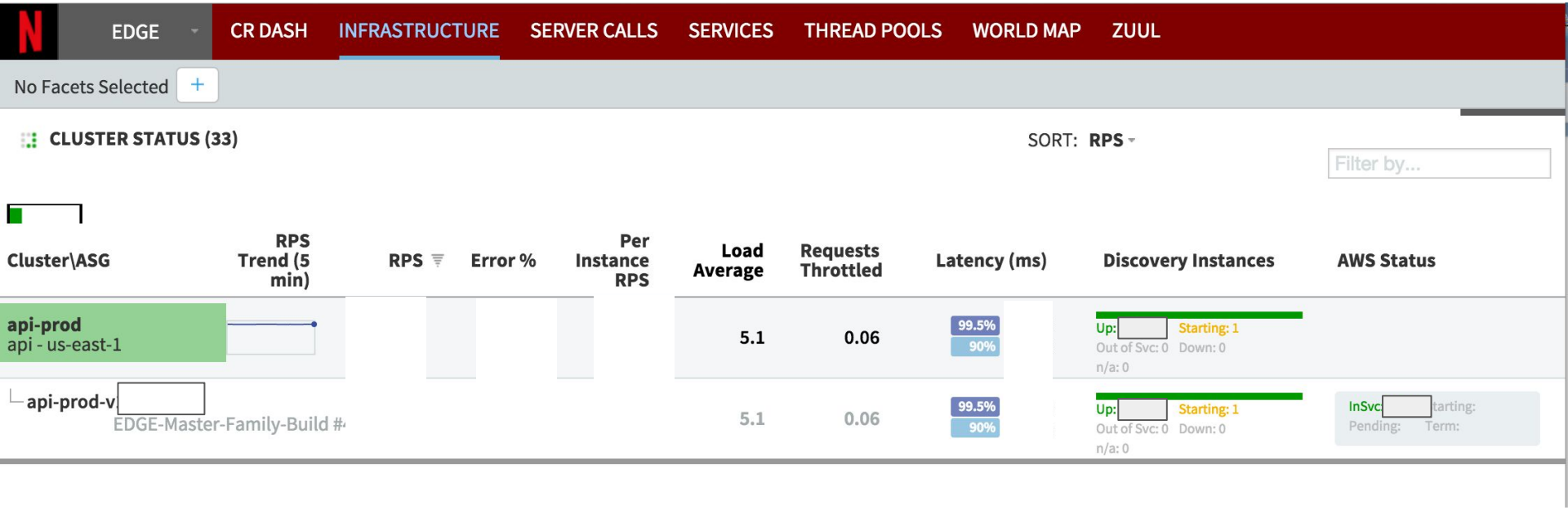
ENDPOINTS
Overview
Manage
Health
Activity

RESOURCES
.Next SDK
.Next Javadoc
.Next User Guide
.Next REPL (PROD)
Deployments
Environments

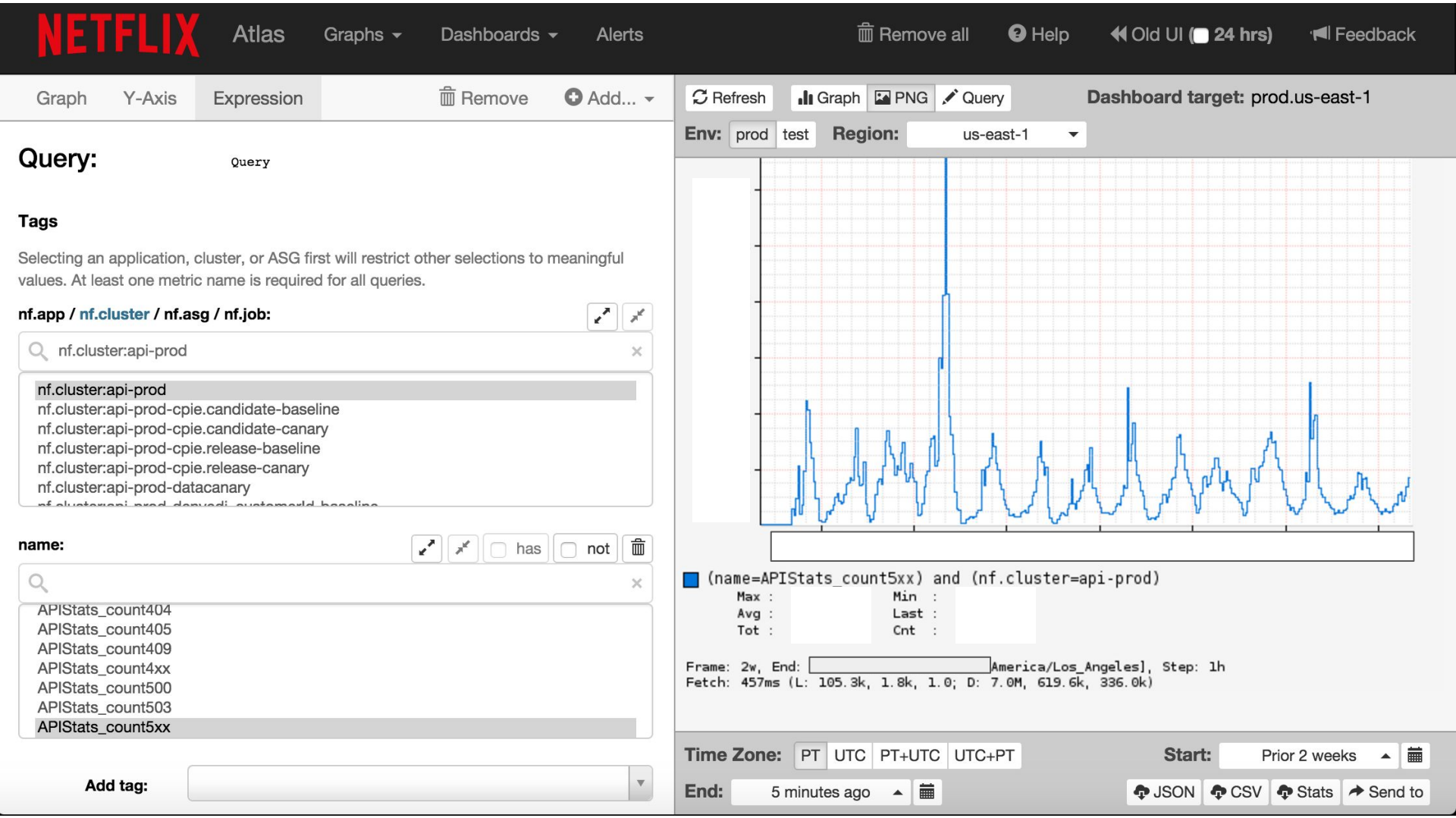
Endpoint Groups

Group	# Endpoints	# Active	Usage	Health	# Requests (e-2w)	Bytecode Size	Owner
tvui	459	69	76%			184.4 MB	tflix.com
mobile	53	26	52%			20.9 MB	e@netflix.com
android	25	16	80%			27.8 MB	flix.com
desktop	73	63	70%			6.0 MB	s@netflix.com
win	35	34	68%			52.1 MB	@netflix.com
users	5	5	50%			8.9 MB	s@netflix.com
atv	31	6	15%			9.8 MB	tflix.com
halo	1	1	20%			2.2 MB	netflix.com
streaming	2	2	40%			58.9 kB	netflix.com
shakti	154	72	72%			2.9 MB	x.com
cbp	10	10	83%			3.3 MB	@netflix.com
apps	4	3	60%			405.1 kB	netflix.com
ecapi	46	40	66%			1.1 MB	s@netflix.com
ios	2	2	10%			1.3 MB	netflix.com
account	5	5	50%			69.3 kB	s@netflix.com
internal	23	20	66%			1.4 MB	s@netflix.com
signup	4	4	80%			204.5 kB	netflix.com
jellyvision	13	12	60%			463.4 kB	tflix.com
utility	9	9	60%			747.8 kB	netflix.com
dse	1	1	20%			74.3 kB	netflix.com
social	6	6	60%			265.1 kB	netflix.com

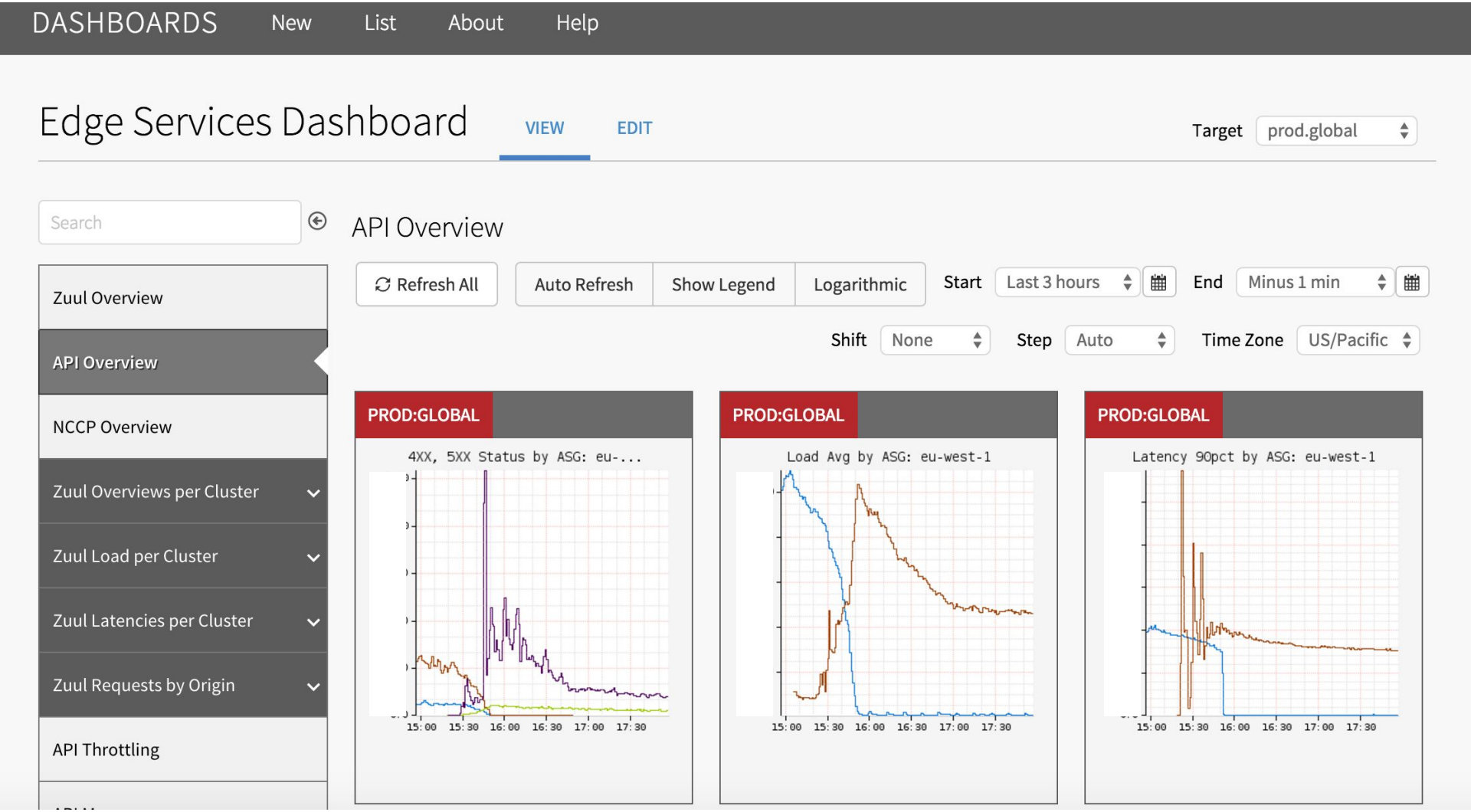
Operations


EDGE
CR DASH
INFRASTRUCTURE
SERVER CALLS
SERVICES
THREAD POOLS
WORLD MAP
ZUUL
No Facets Selected
CLUSTER STATUS (33)
SORT: RPS
Filter by...
Cluster\ASG
RPS Trend (5 min)
RPS
Error %
Per Instance RPS
Load Average
Requests Throttled
Latency (ms)
Discovery Instances
AWS Status
api-prod
api - us-east-1
5.1
0.06
99.5%
90%
Up:
Starting: 1
Out of Svc: 0
Down: 0
n/a: 0
api-prod-v
EDGE-Master-Family-Build #
5.1
0.06
99.5%
90%
Up:
Starting: 1
Out of Svc: 0
Down: 0
n/a: 0
InSvc
Pending:
Term:

Operations


NETFLIX
Atlas
Graphs
Dashboards
Alerts
Remove all
Help
Old UI (24 hrs)
Feedback
Graph
Y-Axis
Expression
Remove
Add...
Query:
Query
Tags
Selecting an application, cluster, or ASG first will restrict other selections to meaningful values. At least one metric name is required for all queries.
nf.app / nf.cluster / nf.asg / nf.job:
nf.cluster:api-prod
nf.cluster:api-prod
nf.cluster:api-prod-cpie.candidate-baseline
nf.cluster:api-prod-cpie.candidate-canary
nf.cluster:api-prod-cpie.release-baseline
nf.cluster:api-prod-cpie.release-canary
nf.cluster:api-prod-datacanary
name:
has
not
APIStats_count404
APIStats_count405
APIStats_count409
APIStats_count4xx
APIStats_count500
APIStats_count503
APIStats_count5xx
Add tag:
Refresh
Graph
PNG
Query
Dashboard target: prod.us-east-1
Env:
prod
test
Region:
us-east-1
(name=APIStats_count5xx) and (nf.cluster=api-prod)
Max :
Min :
Avg :
Last :
Tot :
Cnt :
Frame: 2w, End:
America/Los_Angeles], Step: 1h
Fetch: 457ms (L: 105.3k, 1.8k, 1.0; D: 7.0M, 619.6k, 336.0k)
Time Zone:
PT
UTC
PT+UTC
UTC+PT
Start:
Prior 2 weeks
End:
5 minutes ago
JSON
CSV
Stats
Send to

Operations


DASHBOARDS
New
List
About
Help
Edge Services Dashboard
VIEW
EDIT
Target
prod.global
Search
API Overview
Zuul Overview
API Overview
NCCP Overview
Zuul Overviews per Cluster
Zuul Load per Cluster
Zuul Latencies per Cluster
Zuul Requests by Origin
API Throttling
Refresh All
Auto Refresh
Show Legend
Logarithmic
Start
Last 3 hours
End
Minus 1 min
Shift
None
Step
Auto
Time Zone
US/Pacific
PROD:GLOBAL
4XX, 5XX Status by ASG: eu-...
15:00 15:30 16:00 16:30 17:00 17:30
PROD:GLOBAL
Load Avg by ASG: eu-west-1
15:00 15:30 16:00 16:30 17:00 17:30
PROD:GLOBAL
Latency 90pct by ASG: eu-west-1
15:00 15:30 16:00 16:30 17:00 17:30

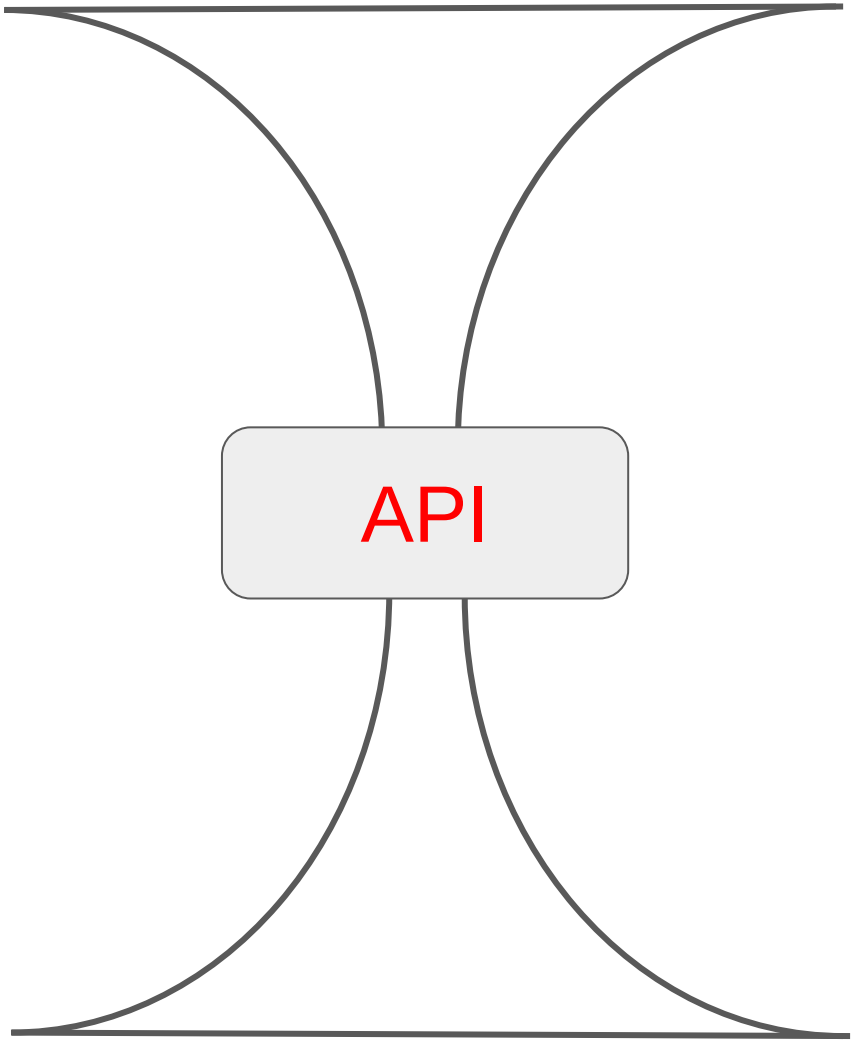
Real-time analysis

Submit a query, see requests in real time.

http://www.slideshare.net/g9yuayon/qcon-talk-on-netflix-mantis-a-stream-processing-system

Netflix API

- Architecture
- Resiliency
- Developer velocity
- Tooling and DevOps
- **Current and future directions**

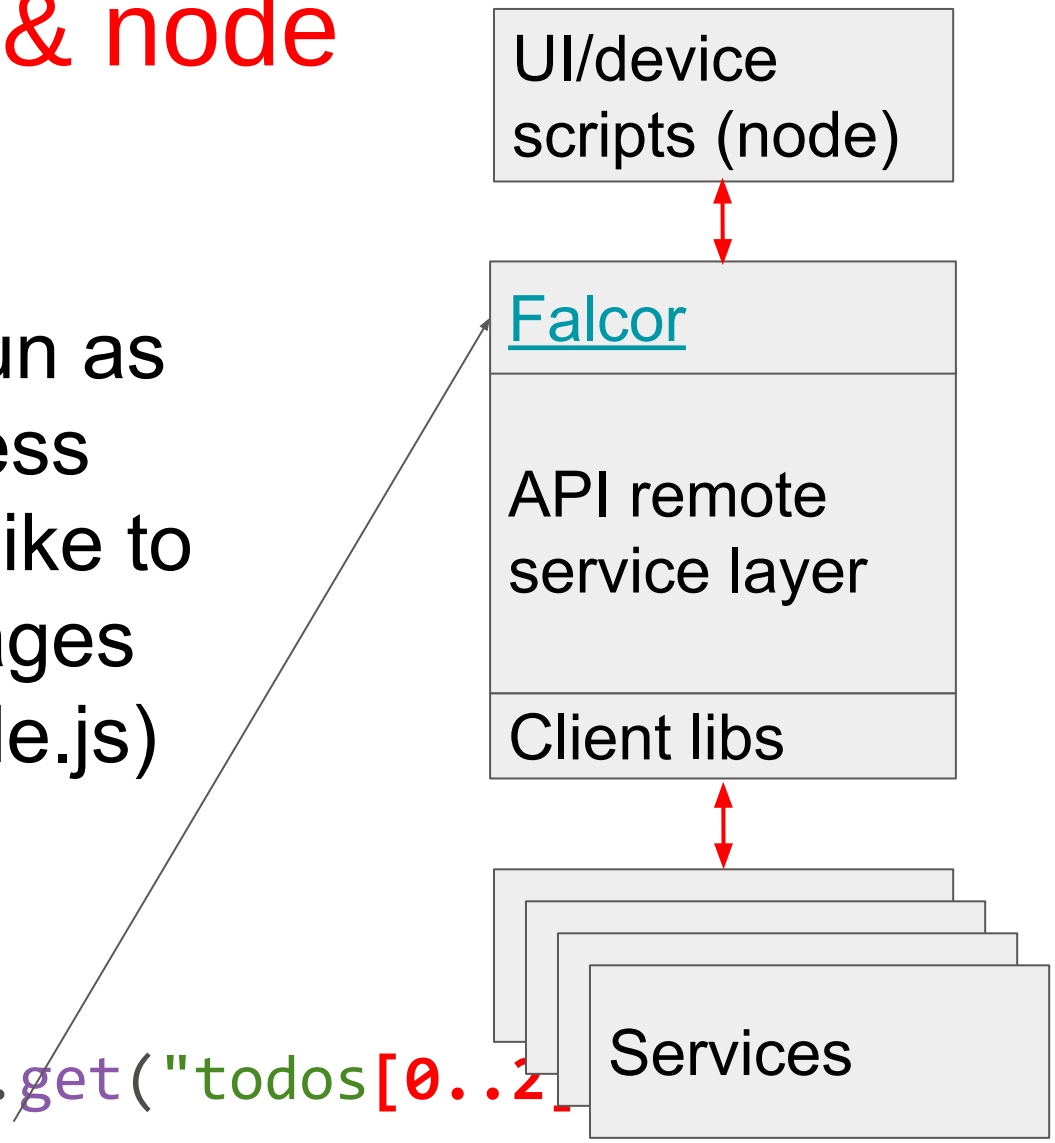


What we've grown to

- > 900 active endpoints
- ~60 direct dependencies
- 78 thread pools
- 1000+ threads
- high memory usage

Script isolation & node

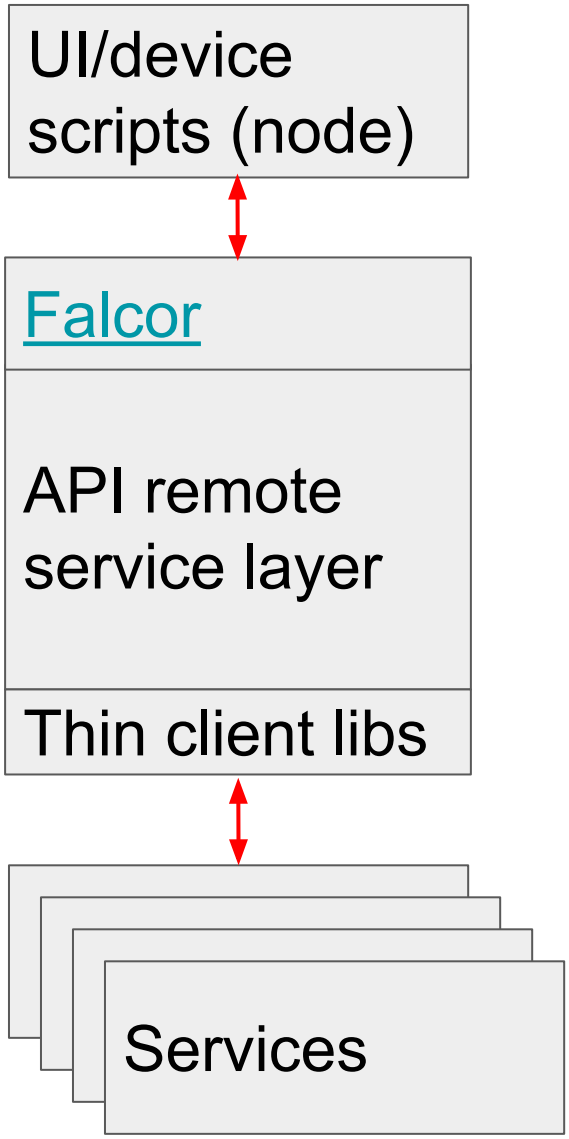
- Groovy scripts run as part of API process
- UI teams would like to use other languages (in particular node.js)




```
var response = model.get("todos[0..2]
['name','done']");
```

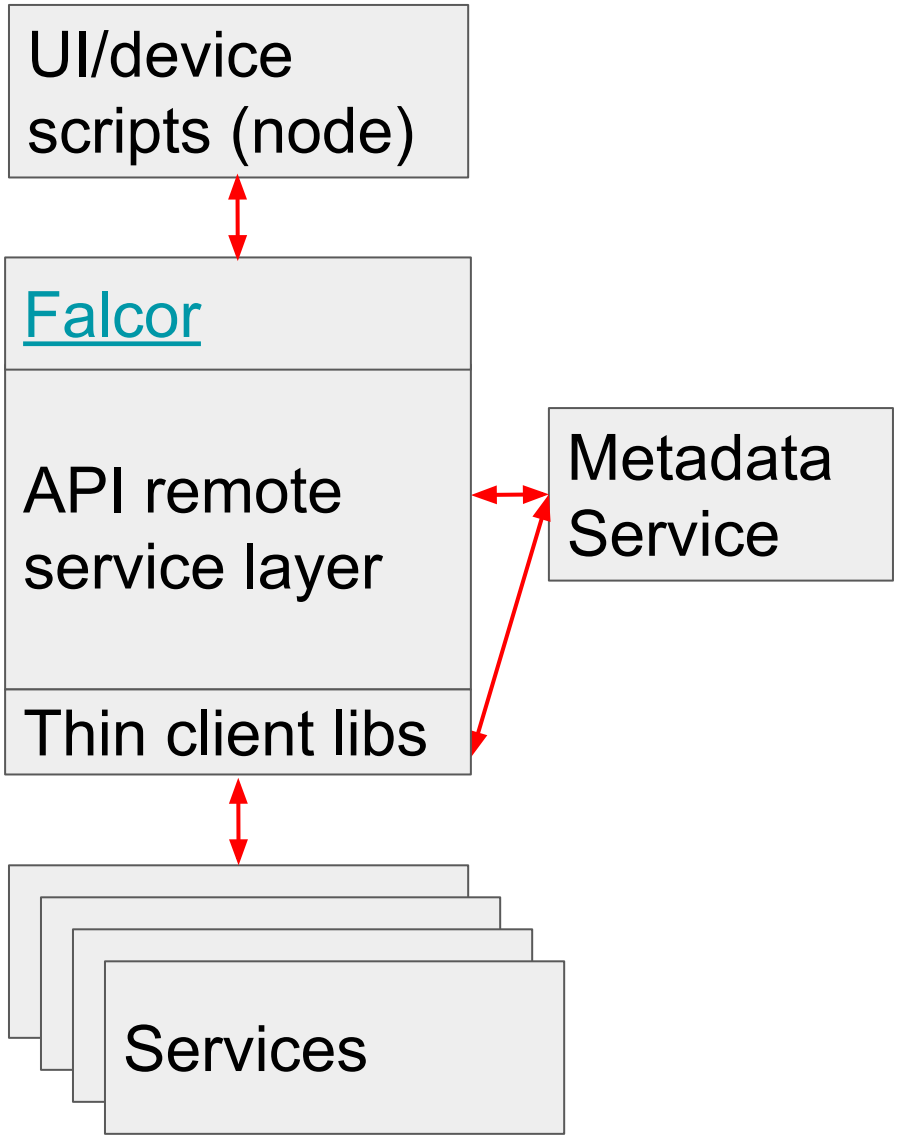
Thin client libraries

- Fat client libraries
  - business logic and have
  - multiple dependencies
- Move business logic and dependencies to services



Remove metadata from API servers

- Metadata takes up significant memory in API servers
- Challenge: reduce chattiness to metadata



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