MICROSERVICES I PRAKTIKEN

från tröga monoliter till en arkitektur för kortare ledtider, högre skalbarhet och ökad feltolerans

MAGNUS LARSSON

2015.05.21 | CALLISTAENTERPRISE.SE

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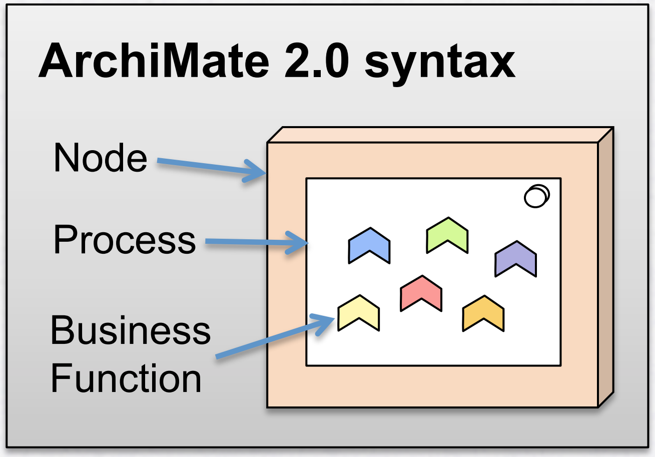
AGENDA

- What's the problem?
- New solutions to old problems...
- What's a microservice?
- New challenges with microservices
- Implementing microservices
- Demonstration

WHAT'S THE PROBLEM??

- Well known problems with monolithic applications
  - Poor scalability and resilience
  - Long release cycles
- ...we hade tried to solve these problems before (and failed?)...
- But there are new opportunities now!



HISTORY OF MICROSERVICES

- Microservices was first heard of in May 2011
- Success stories from early adopters
  migrating from monoliths to microservices
  - Amazon (http://goo.gl/LfsD67)
  - eBay (http://goo.gl/dodV2c)
  - Gilt (http://goo.gl/yVVox9)
  - Groupon (https://goo.gl/uKTtAs)
  - Karma (https://goo.gl/kXObAO)
  - Netflix: Part 1, part 2 and Fast Delivery
    (https://goo.gl/MVgHM1, https://goo.gl/fDeZ5A, https://goo.gl/hN6ZCL)
  - SoundCloud: Part 1, part 2 and part 3
    (https://goo.gl/Xq0Cgm, https://goo.gl/swJ8Vt, https://goo.gl/J2oN8I)

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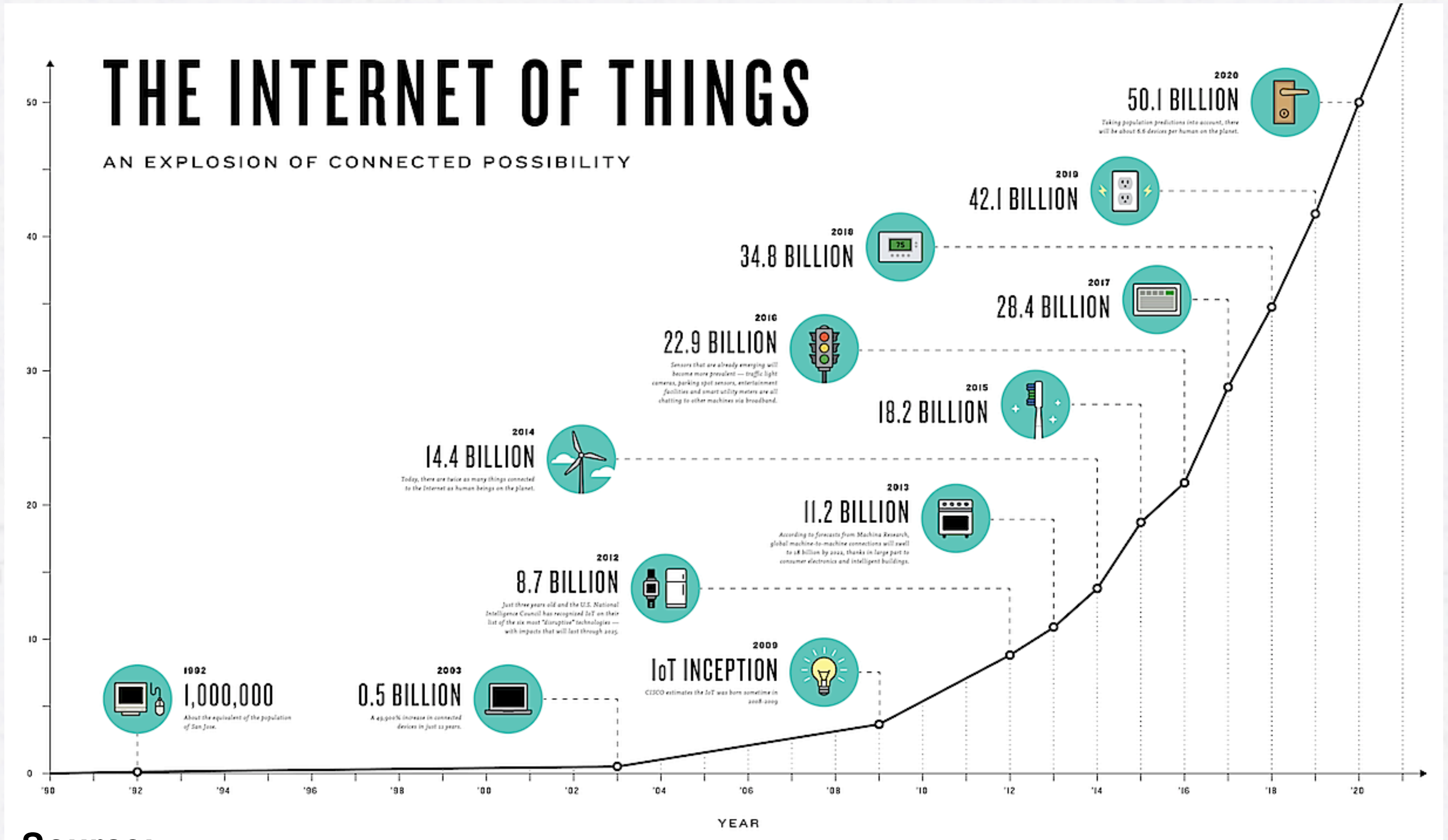
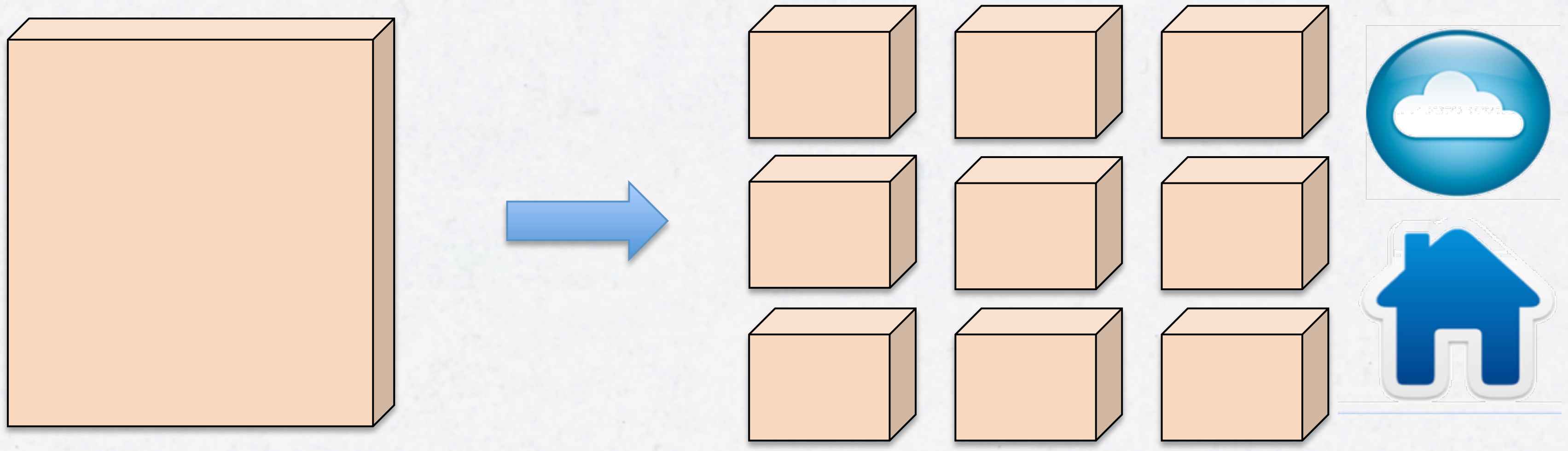
THE SCALABILITY CHALLENGE…



Source:
http://www.theconnectivist.com/2014/05/infographic-the-growth-of-the-internet-of-things/

NEW SOLUTIONS TO OLD PROBLEMS

- Strong trend moving from "Big Iron" to many small servers
  - Typically virtual servers
  - In cloud or/and on premises
  - Better price/performance

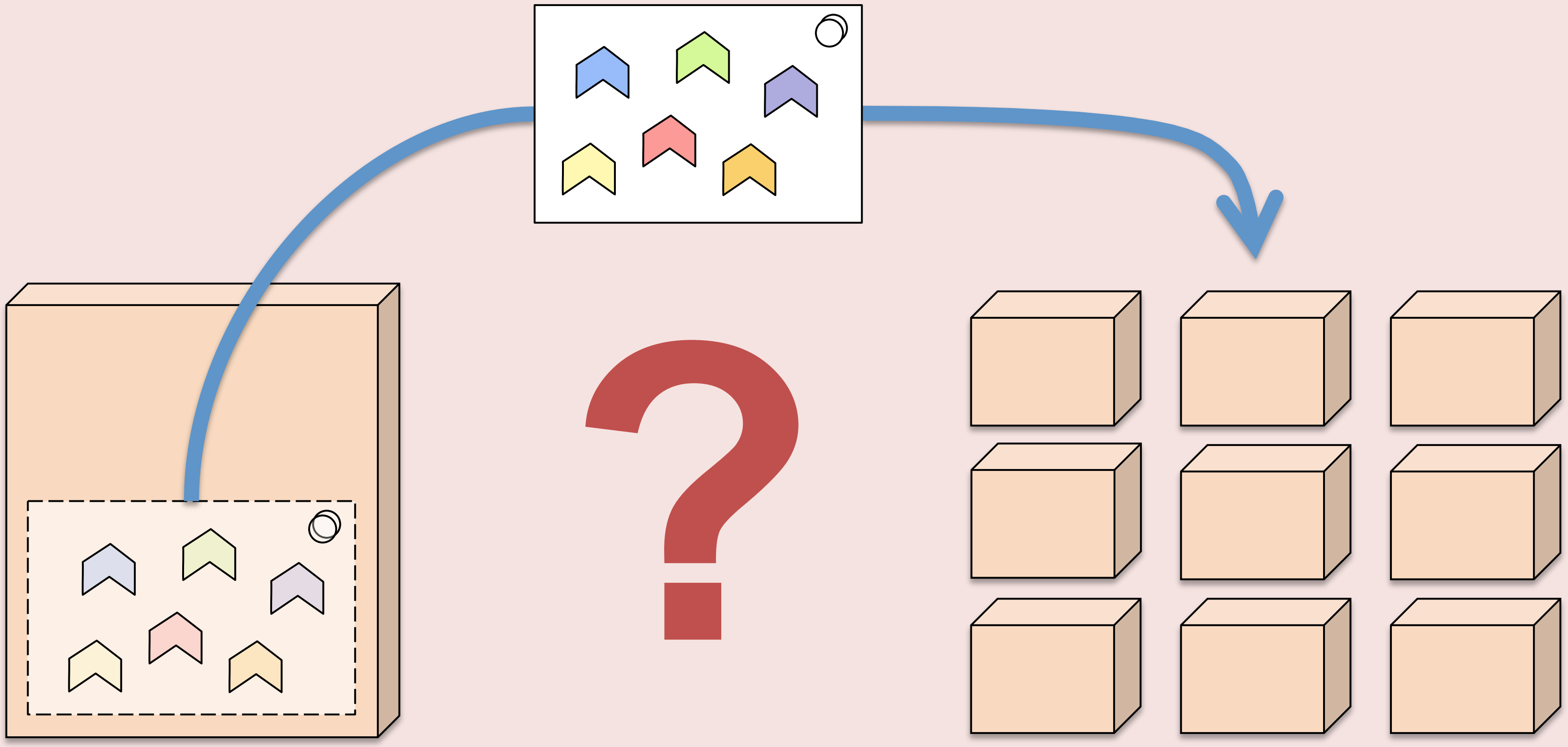


NEW SOLUTIONS TO OLD PROBLEMS

- *Cloud computing* makes it easier to manage many small servers
  - **IaaS: Infrastructure as a Service**
    - » Deliver virtual servers
    - » E.g. Amazon EC2, Windows Azure, Google Compute Engine et. al.
  - **PaaS: Platform as a Service**
    - » Deliver an application platform
    - » E.g. Heroku, Red Hat OpenShift, Pivotal Cloud Foundry et. Al.
    - » **Note:** Some PaaS can be used on premises, e.g. OpenShift and Cloud Foundry
  - **Docker, the Container revolution…**
    - » *IaaS* + *PaaS* ➔ *CaaS* **?**

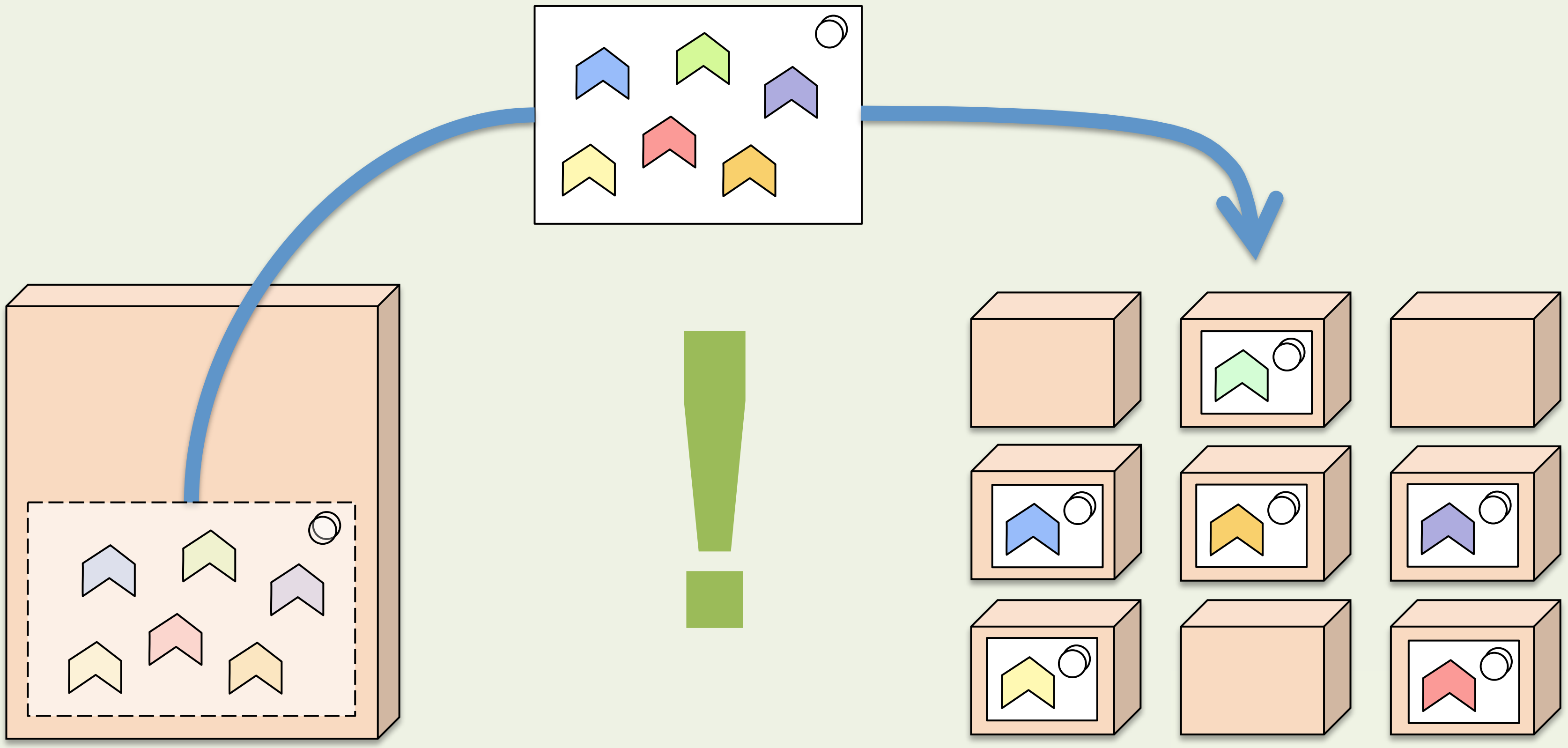
NEW SOLUTIONS TO OLD PROBLEMS

- How to fit monolithic applications in a number of small boxes?



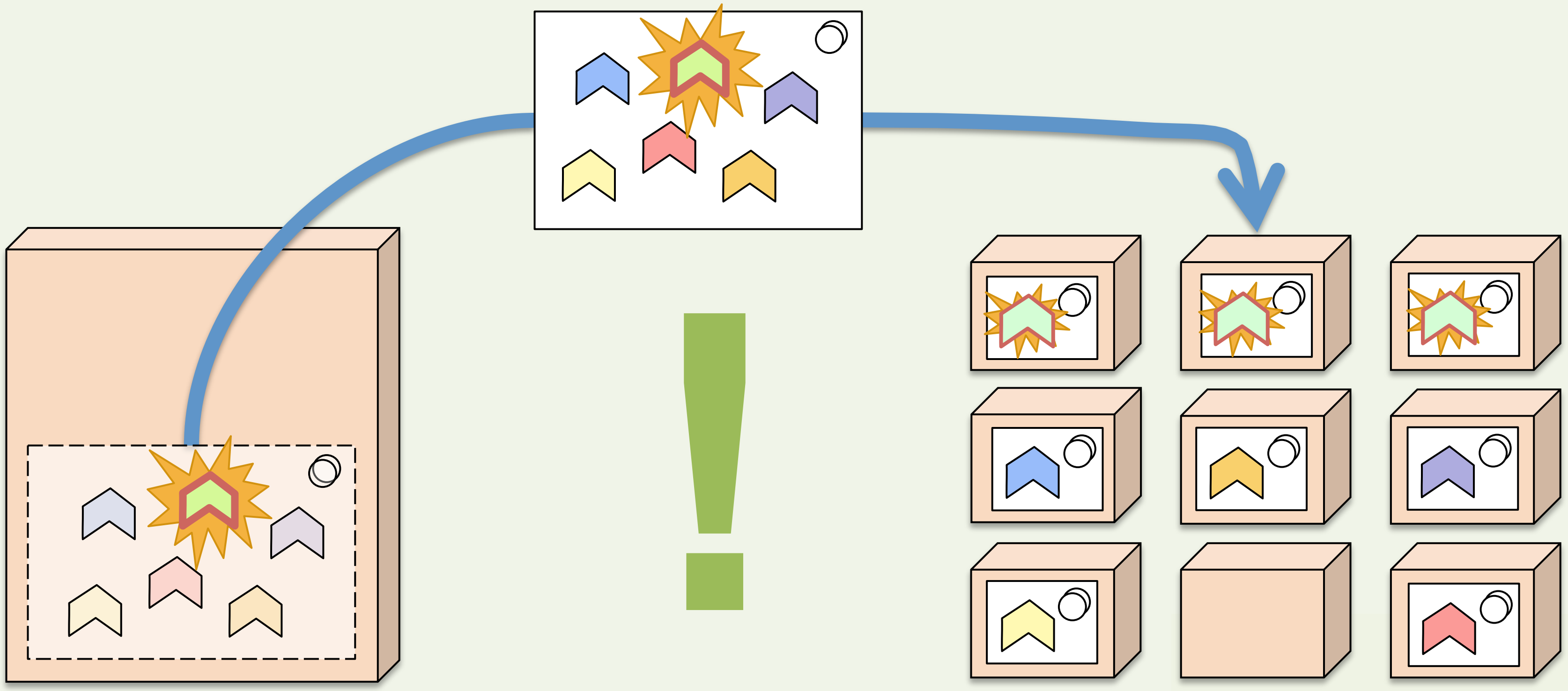
NEW SOLUTIONS TO OLD PROBLEMS

- We need to split the monolith to make it fit…



NEW SOLUTIONS TO OLD PROBLEMS

- Splitting the monolith also makes it easier to scale…
  - Auto scaling provided by platforms



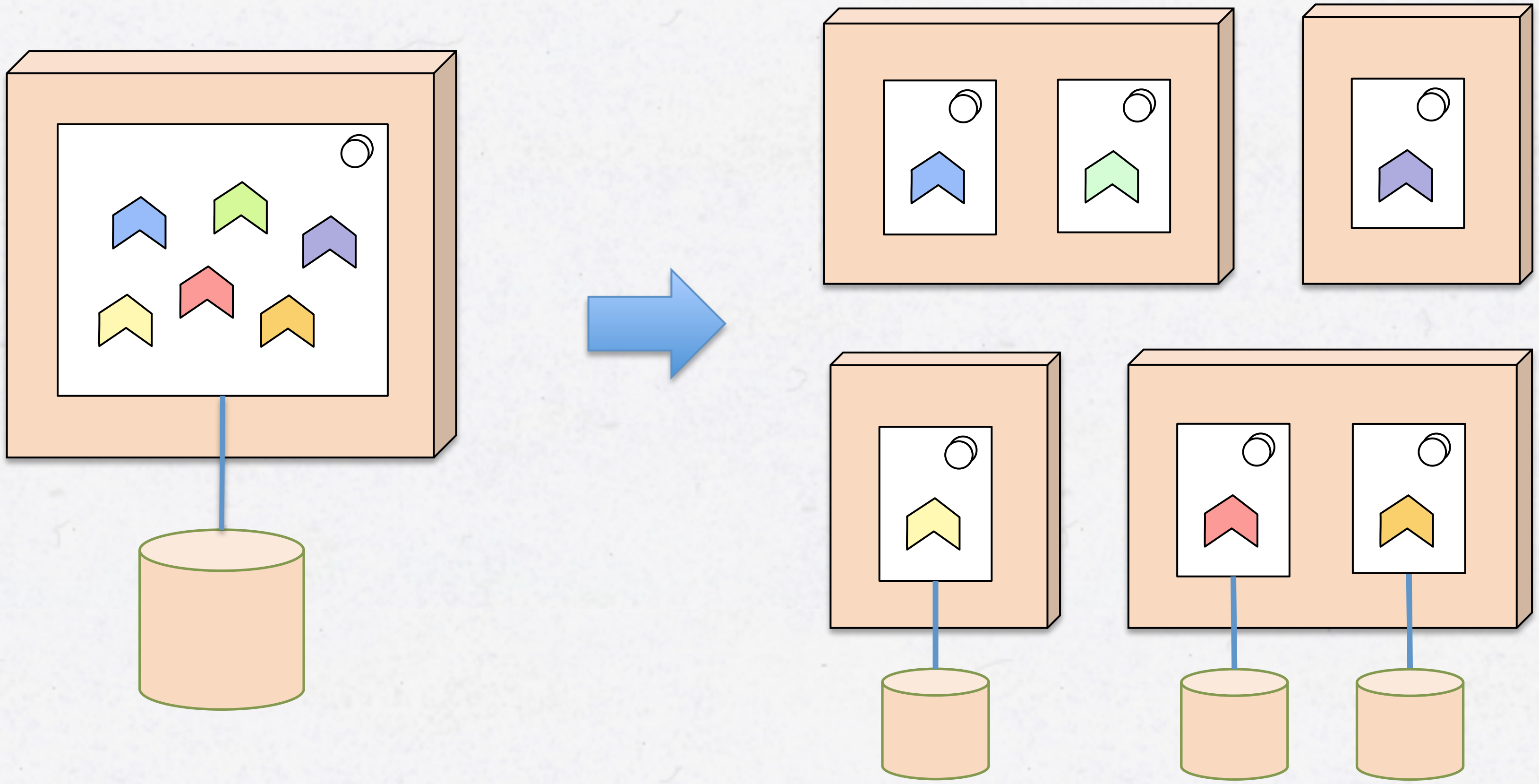
WHAT'S A MICROSERVICE?

- A software component that is independently replaceable and upgradeable

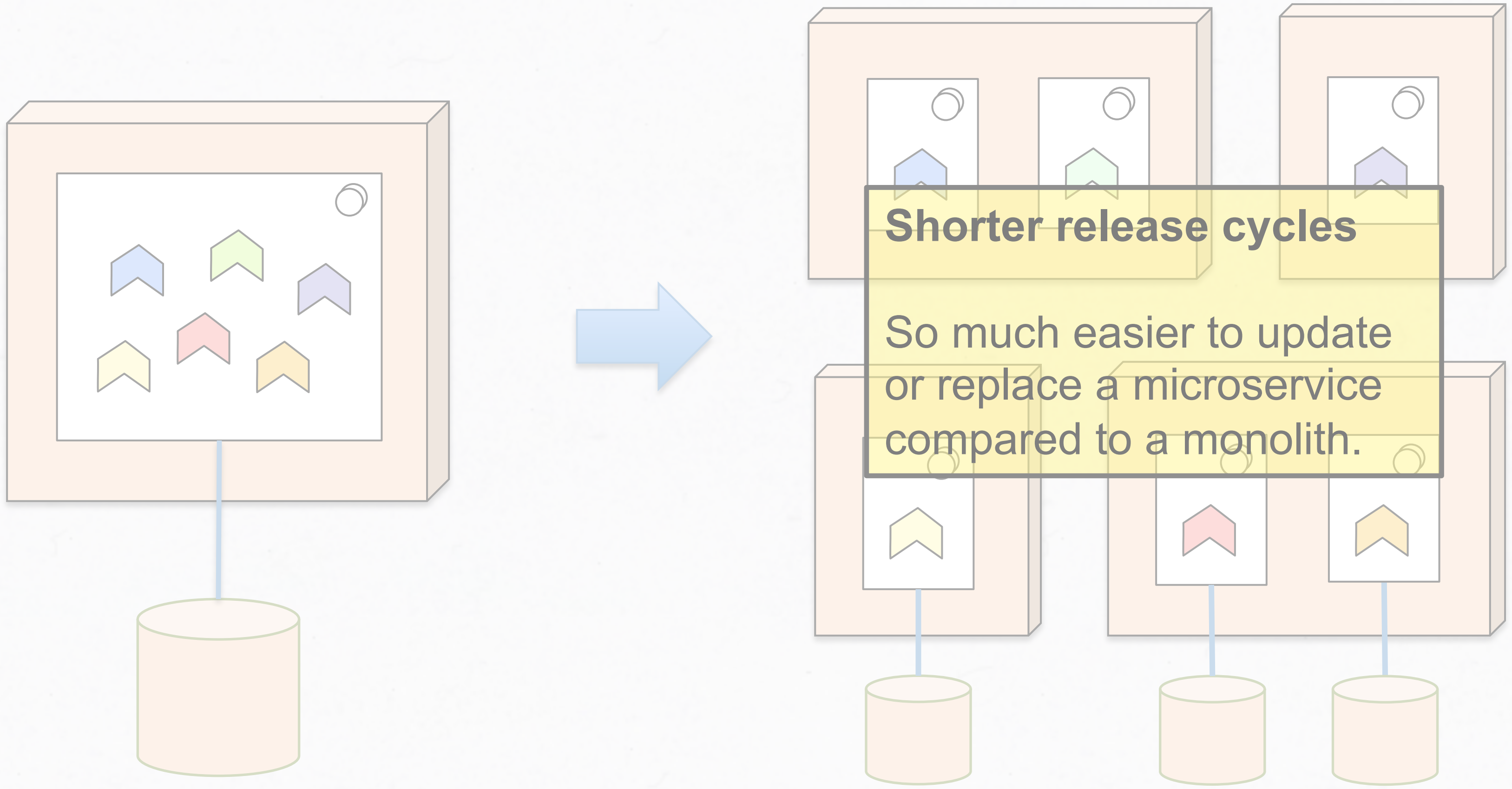
- Share nothing architecture
  - They don't share databases!
  - Only communicate through well defined interfaces,
    - » E.g. REST services or queuing mechanisms

- Typically deployed as separate runtime processes

WHAT'S A MICROSERVICE?



WHAT'S A MICROSERVICE?



Shorter release cycles

So much easier to update or replace a microservice compared to a monolith.

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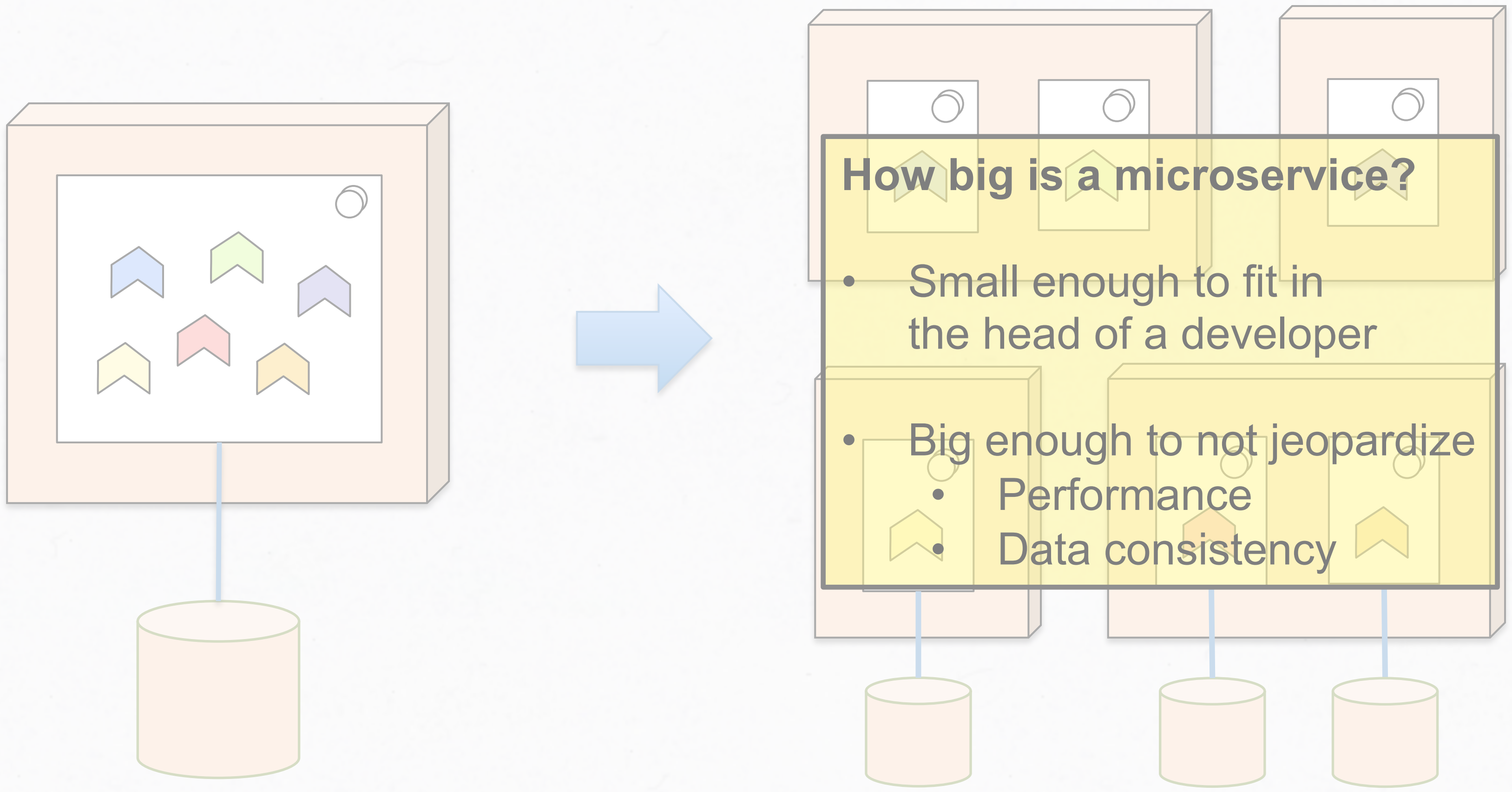
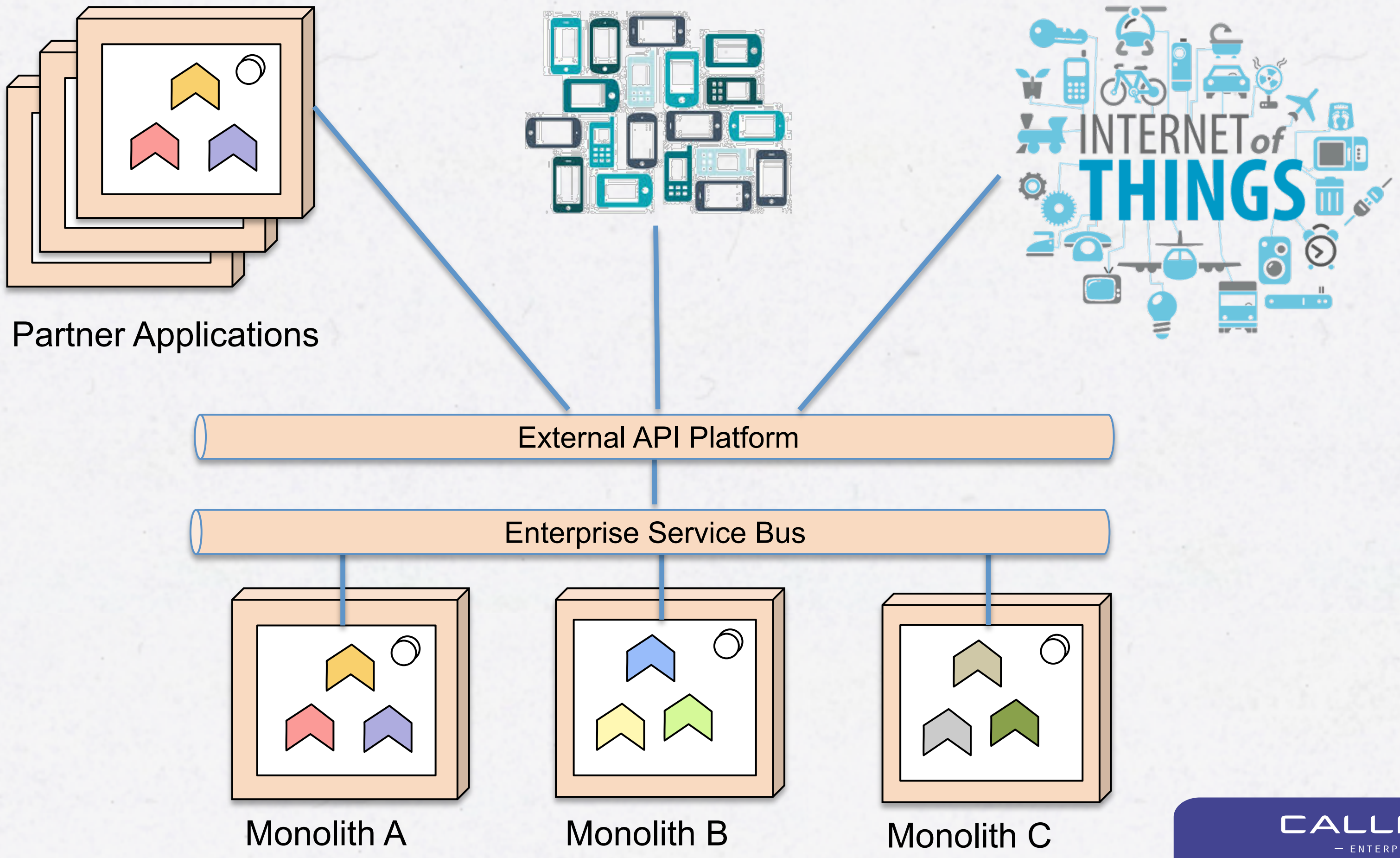
WHAT'S A MICROSERVICE?



How big is a microservice?

- Small enough to fit in the head of a developer
- Big enough to not jeopardize
  - Performance
  - Data consistency

HOW DOES MICROSERVICES FIT INTO AN EXISTING SYSTEM LANDSCAPE?



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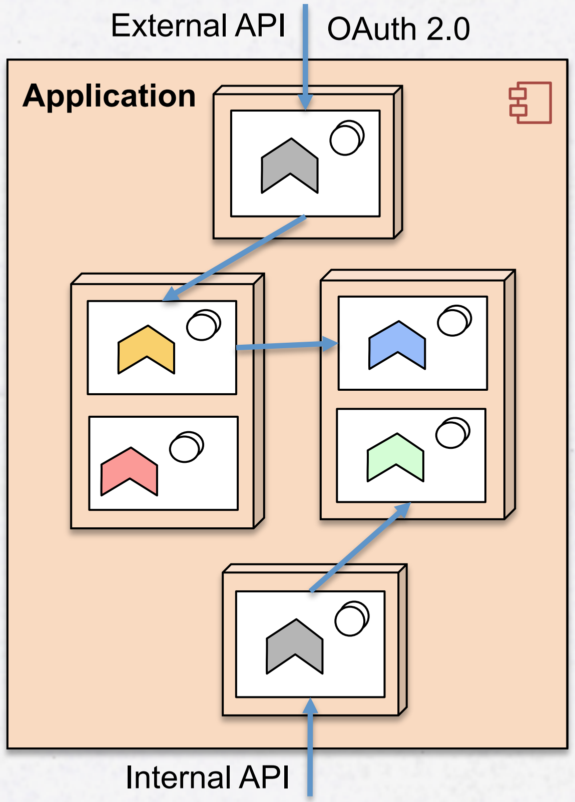
WHAT'S A MICROSERVICE?

- Application level
  - An application is built up by a number of microservices
    - » Deployed on a number of nodes
  - Microservices are typically not exposed outside of the application
    - » Dedicated Edge-services handles requests from the outside (internal and external)
    - » Internal microservices can be upgraded and replaced quickly



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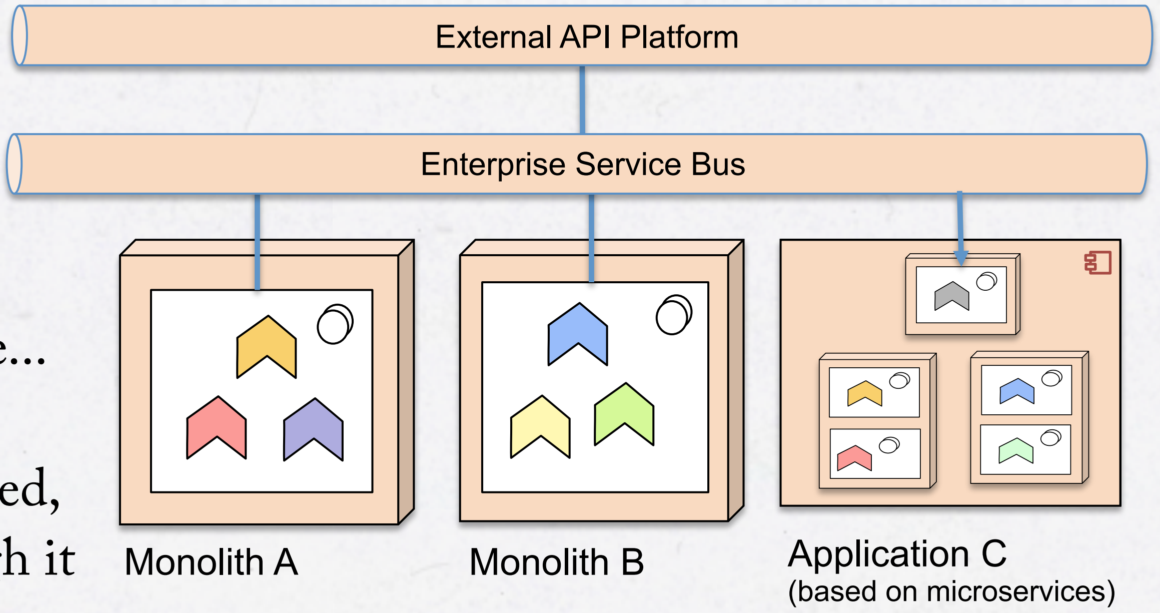
WHAT'S A MICROSERVICE?

- System landscape level…
  - Coexistence with existing applications
  - If a SOA is applied, typically an ESB is in place…
  - If an API platform is applied, external calls comes through it



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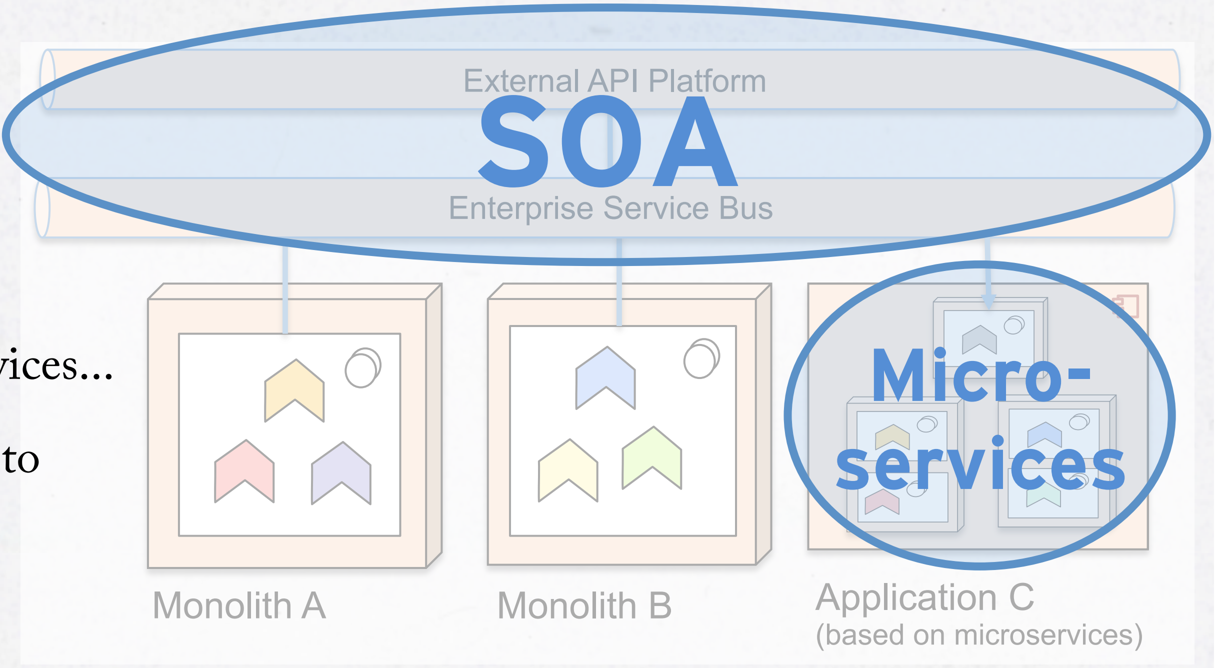
WHAT'S A MICROSERVICE?

- SOA vs. Microservices
  - SOA and microservices don't conflict, they complement each other!
  - SOA is about how to reuse existing functionality as services…
  - Microservices is about how to make functionality to scale better with high resilience and short release cycles…



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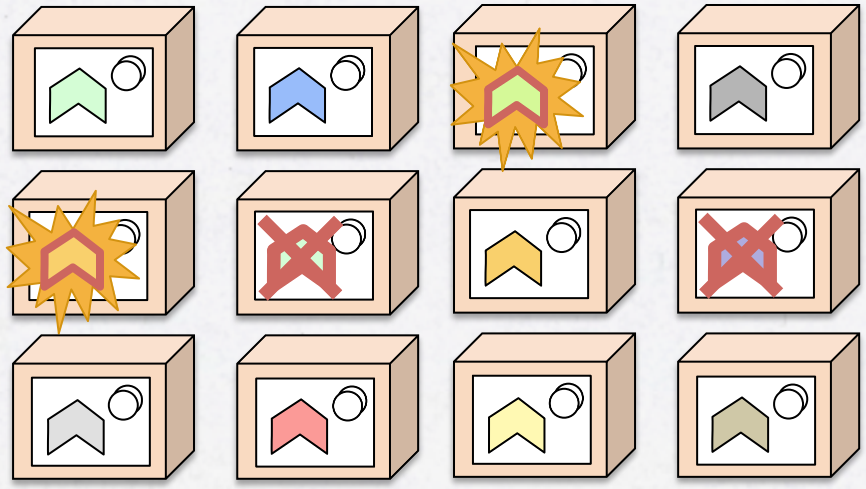
NEW CHALLENGES WITH MICROSERVICES

- Managing large numbers of microservices…
  - Where are they and are they ok???



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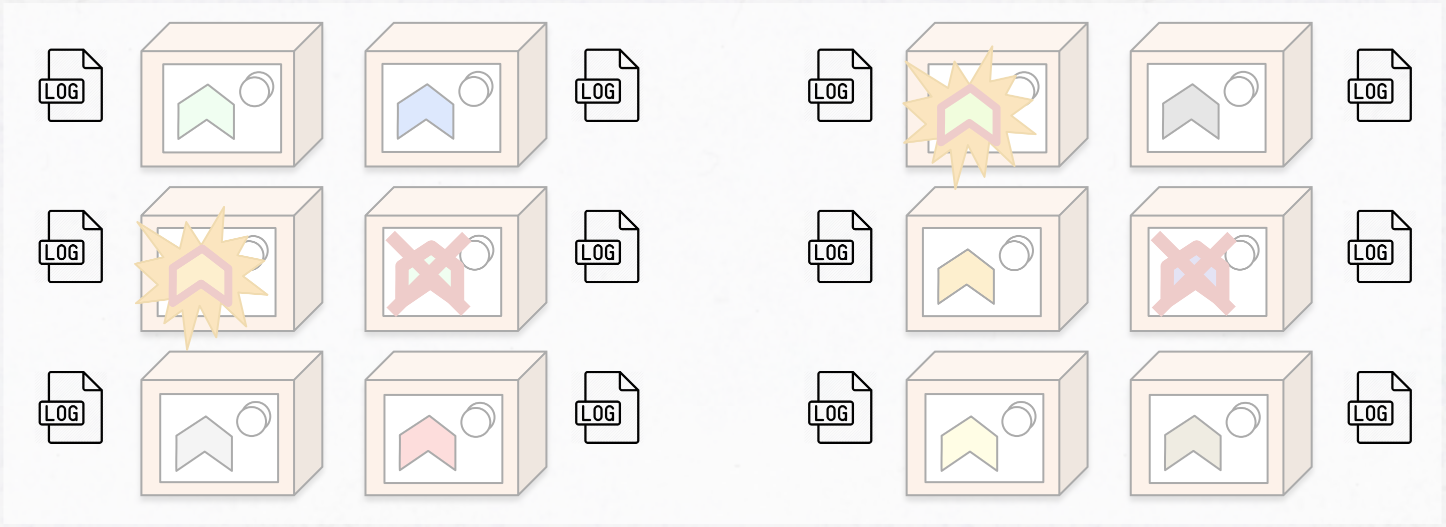
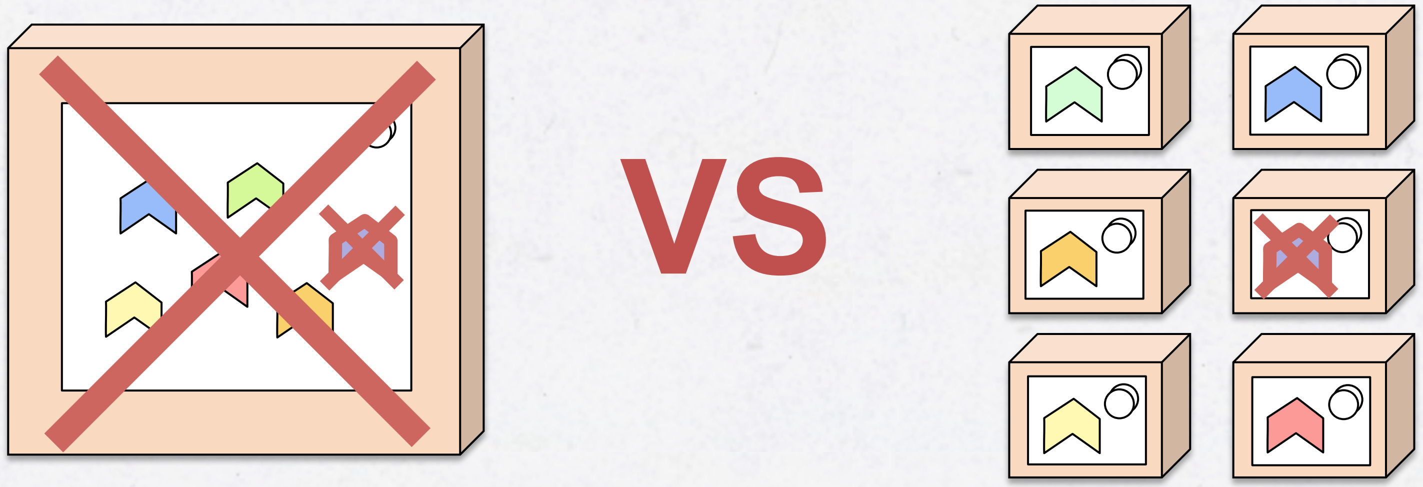
NEW CHALLENGES WITH MICROSERVICES

- What went wrong???



NEW CHALLENGES WITH MICROSERVICES - RESILIENCE

- Minor effect if a small microservice fails than a big monolith…



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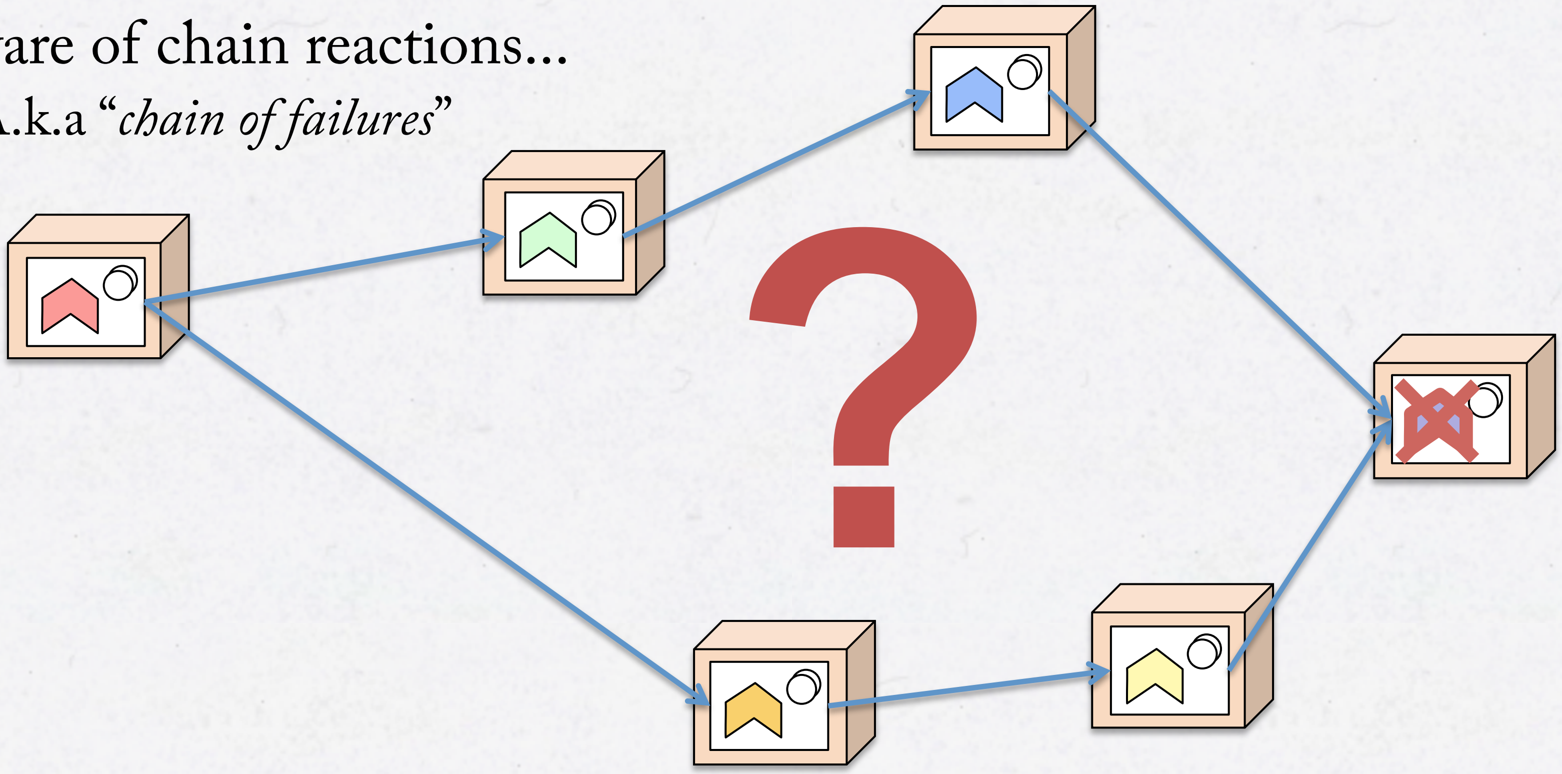
NEW CHALLENGES WITH MICROSERVICES - RESILIENCE

- Beware of chain reactions…
  - A.k.a "*chain of failures*"



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NEW CHALLENGES WITH MICROSERVICES - RESILIENCE

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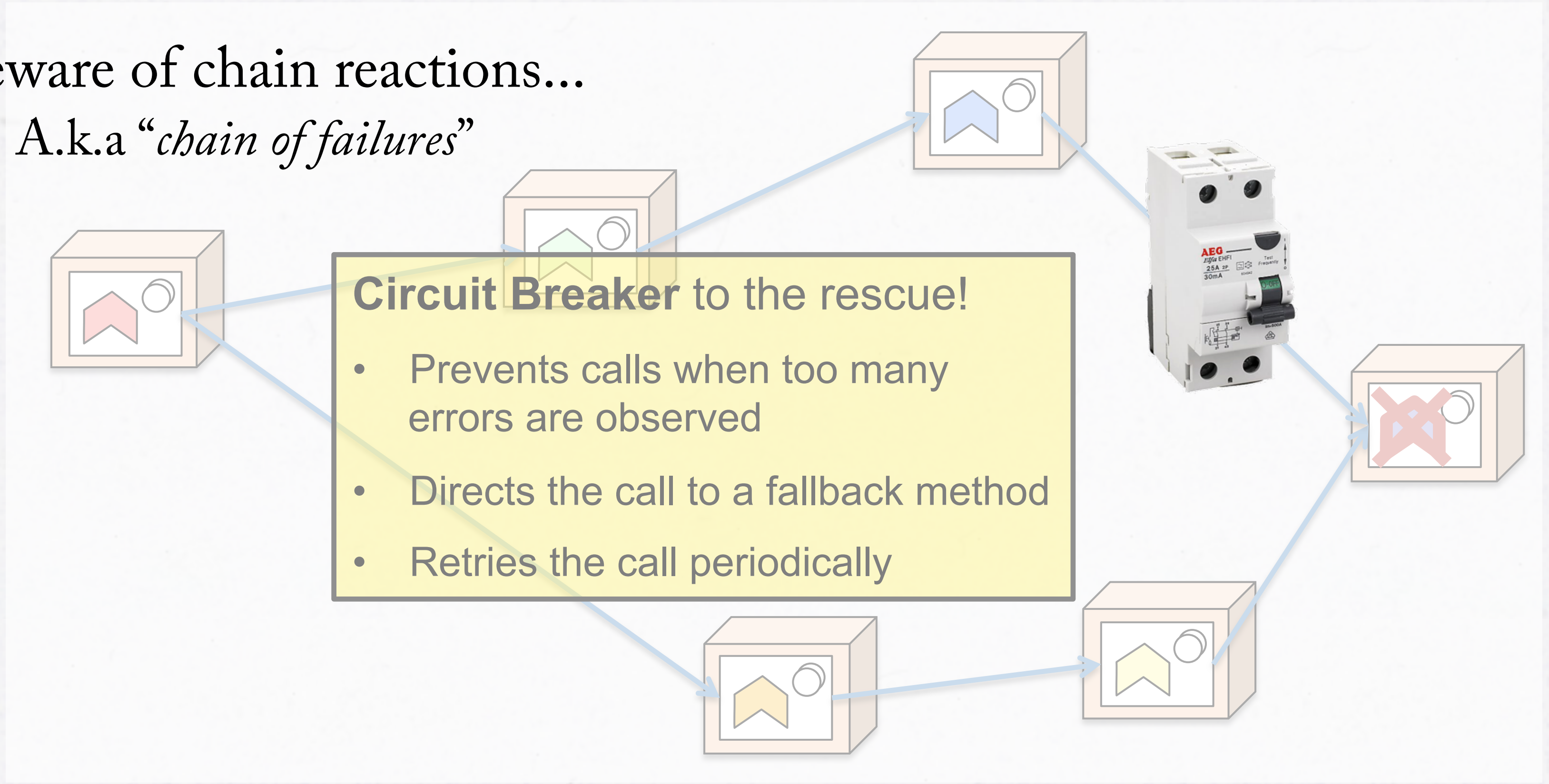
  - A.k.a "*chain of failures*"



Circuit Breaker to the rescue!

- Prevents calls when too many errors are observed
- Directs the call to a fallback method
- Retries the call periodically

NEW CHALLENGES WITH MICROSERVICES

- Managing large numbers of microservices requires tools for
  - **Runtime discovery of services**
    - » New services can auto-register at startup
  - **Dynamic router and load balancer**
    - » Clients can detect new instances as they are started up
  - **Centralized log management**
    - » Collects and visualize log events from distributed processes
  - **Circuit breaker**
    - » Prevent problems with chain of failures
  - **Protecting external API's**
    - » Secure external API's using OAuth 2.0

NEW CHALLENGES WITH MICROSERVICES

Open Source tools to the rescue

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NETFLIX OSS

SPRING CLOUD

elasticsearch.

logstash

Kibana

AGENDA - WHERE ARE WE?

- What's the problem?
- New solutions to old problems...
- What's a microservice?
- New challenges with microservices
- **Implementing microservices**
- Demonstration

IMPLEMENT MICROSERVICES WITH OPEN SOURCE

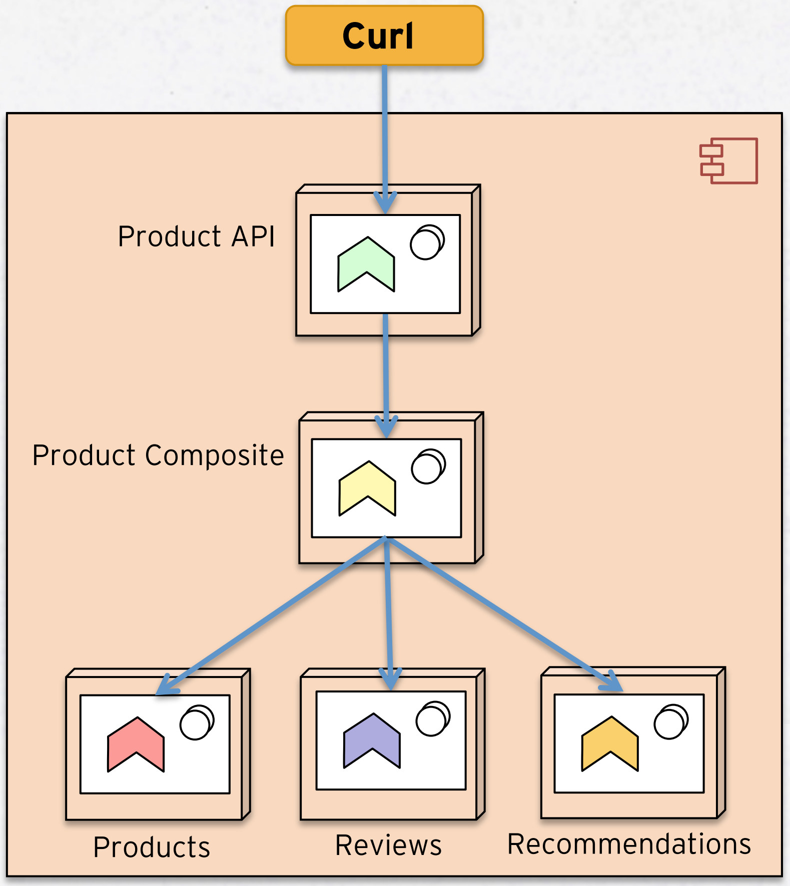
- Netflix OSS (http://goo.gl/DHOf4o)
  - Since 2011, Netflix has been releasing components of their cloud platform as free and open source software
  - Obviously proven in battle…
- Spring Cloud (http://goo.gl/vHVdEp)
  - Spring Cloud simplifies use of Netflix OSS
  - Add own components, e.g. OAuth 2.0 support
  - Based on Spring Boot and the "*convention over configuration*" paradigm
- The ELK stack (https://goo.gl/aCHlhN)
  - **E**lasticsearch, **L**ogstash and **K**ibana
  - Used for centralized log analyses

SOFTWARE COMPONENTS

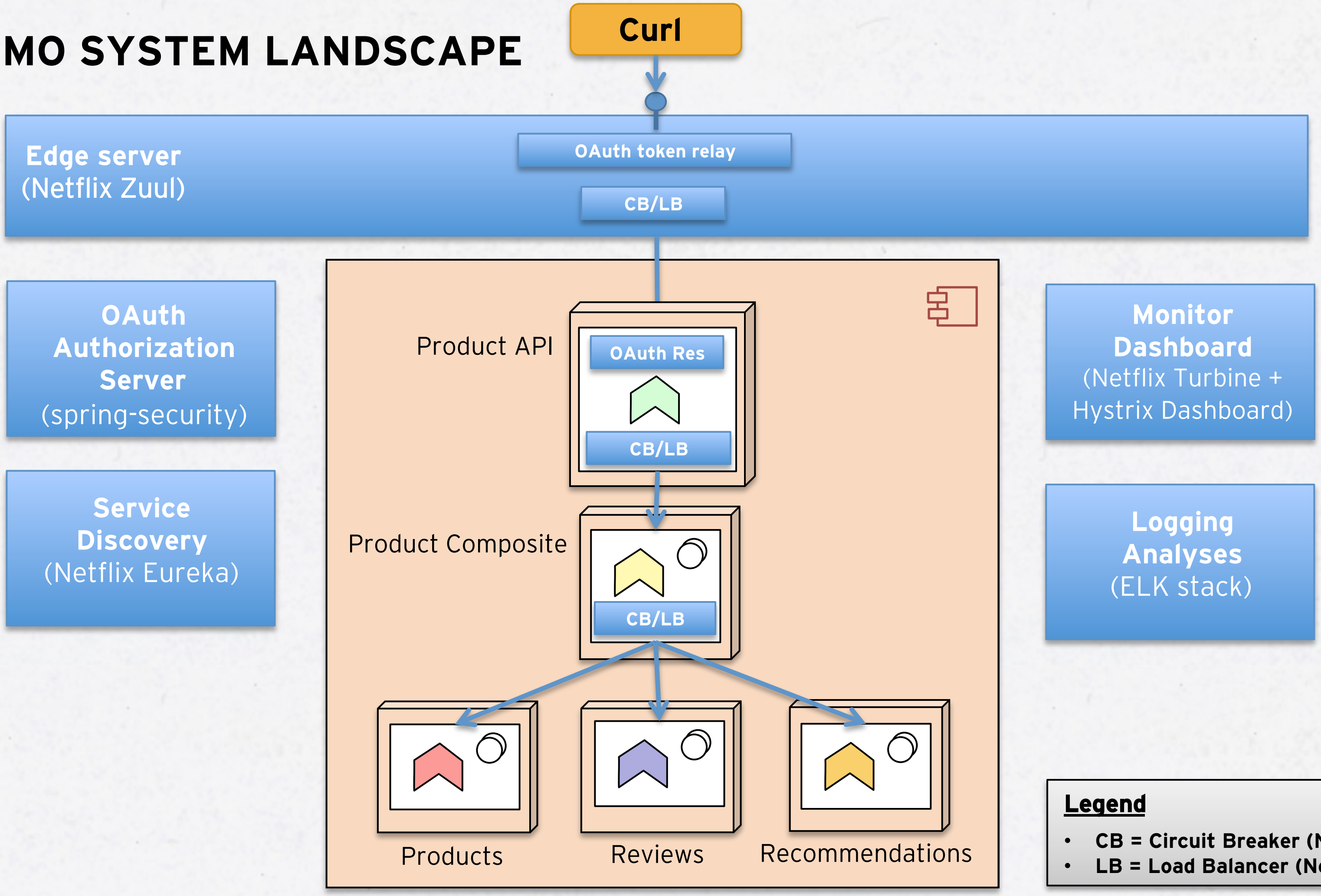
Operations Component	Netflix, Spring, ELK
Service Discovery server	Netflix Eureka
Dynamic Routing and Load Balancer	Netflix Ribbon
Circuit Breaker	Netflix Hystrix
Monitoring	Netflix Hystrix dashboard and Turbine
Edge Server	Netflix Zuul
Central Configuration server	Spring Cloud Config Server
OAuth 2.0 protected API's	Spring Cloud + Spring Security OAuth2
Centralized log analyses	Logstash, Elasticsearch, Kibana (ELK)

DEMO SYSTEM LANDSCAPE

- An API for product-information
- A composite service aggregate information from three core-services
- Plus infrastructure services for OAuth, Discovery and Edge-servers…



DEMO SYSTEM LANDSCAPE

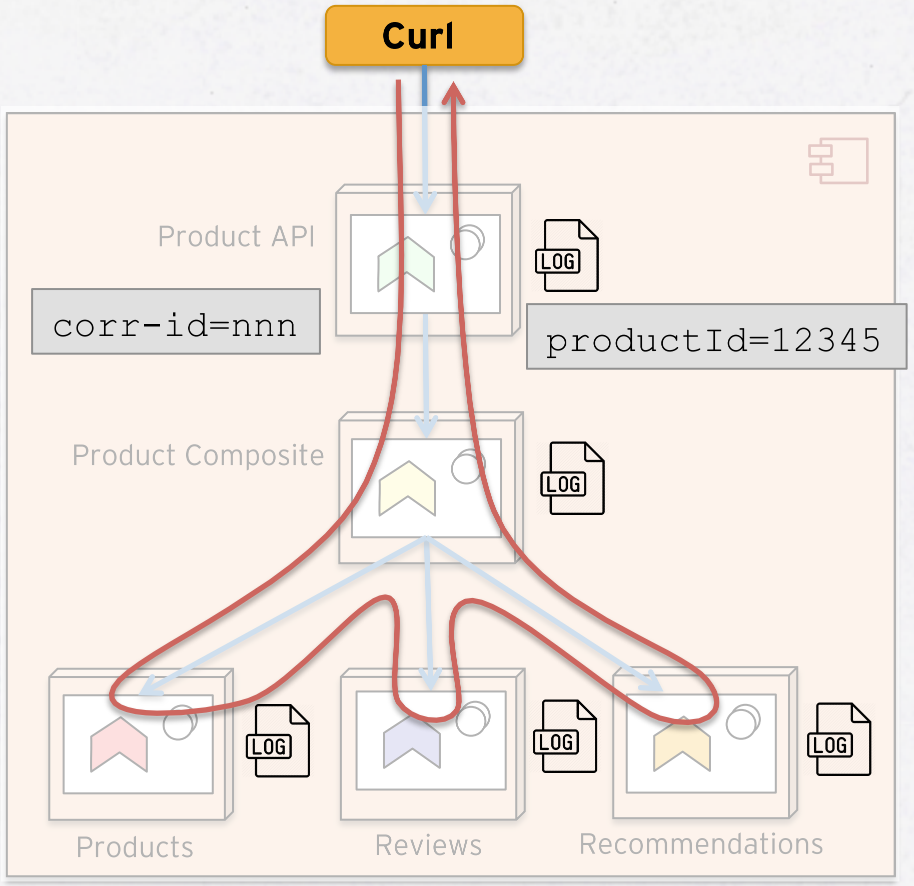


Legend

- CB = Circuit Breaker (Netflix Hystrix)
- LB = Load Balancer (Netflix Ribbon)

CENTRALIZED LOG ANALYSIS

- Each microservice log events to local log-file
- API service marks the request with a correlation-id
- Correlation-id transferred between microservices
- Easy to find correlated log-event in the log-event database



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DEPLOY

- In cloud
  - Using PaaS: Pivotal Web Services

```
$ cf push
```

(https://goo.gl/I3oDGt)

  - Sample configuration file

```
---
memory: 512M
instances: 1
applications:
- name: product-api-service
  path: product-api.jar
```

- On premises
  - Using Docker

```
$ docker-compose start
```

  - Sample configuration file

```
discovery:
  image: callista/discovery-server

pro:
  image: callista/product-service
  links:
    - discovery
```

DEPLOY

- In cloud
  - Using PaaS: Pivotal Web Services

```
$ cf push
```

Java-jar files and Docker images are created by build scripts

- On premises
  - Using Docker

```
$ docker-compose start
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– Sample configuration file

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```
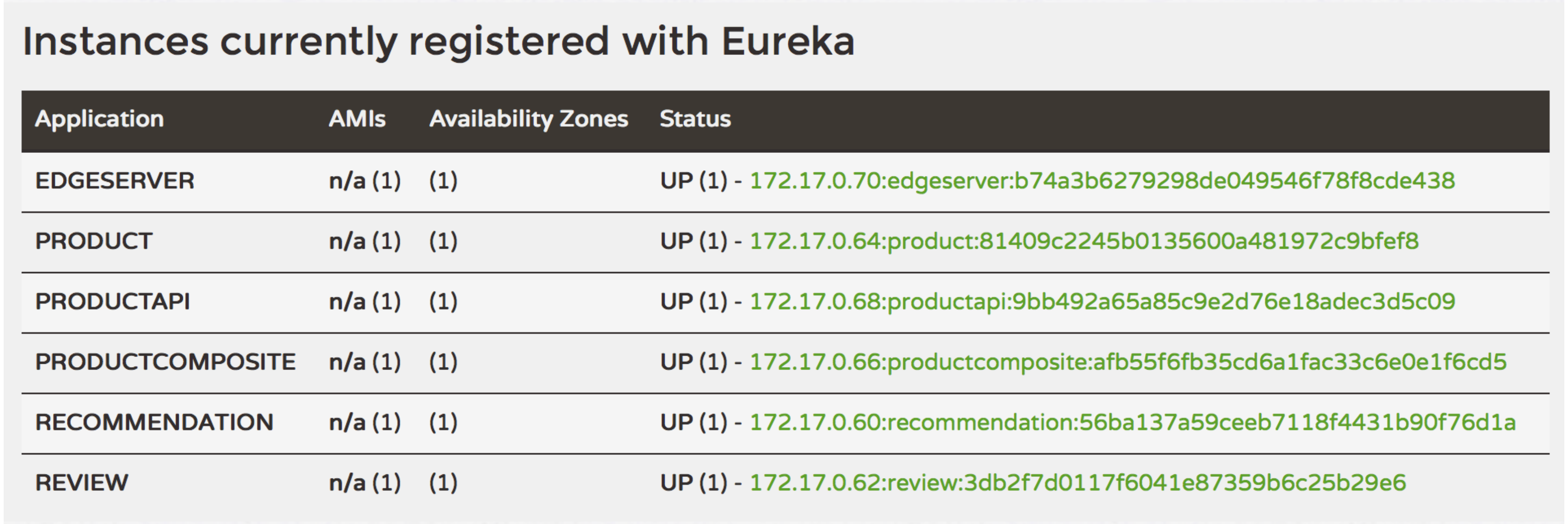

DEMO SLIDES

- Discovery server
- Centralized log analysis
- Scale up
- Resilience

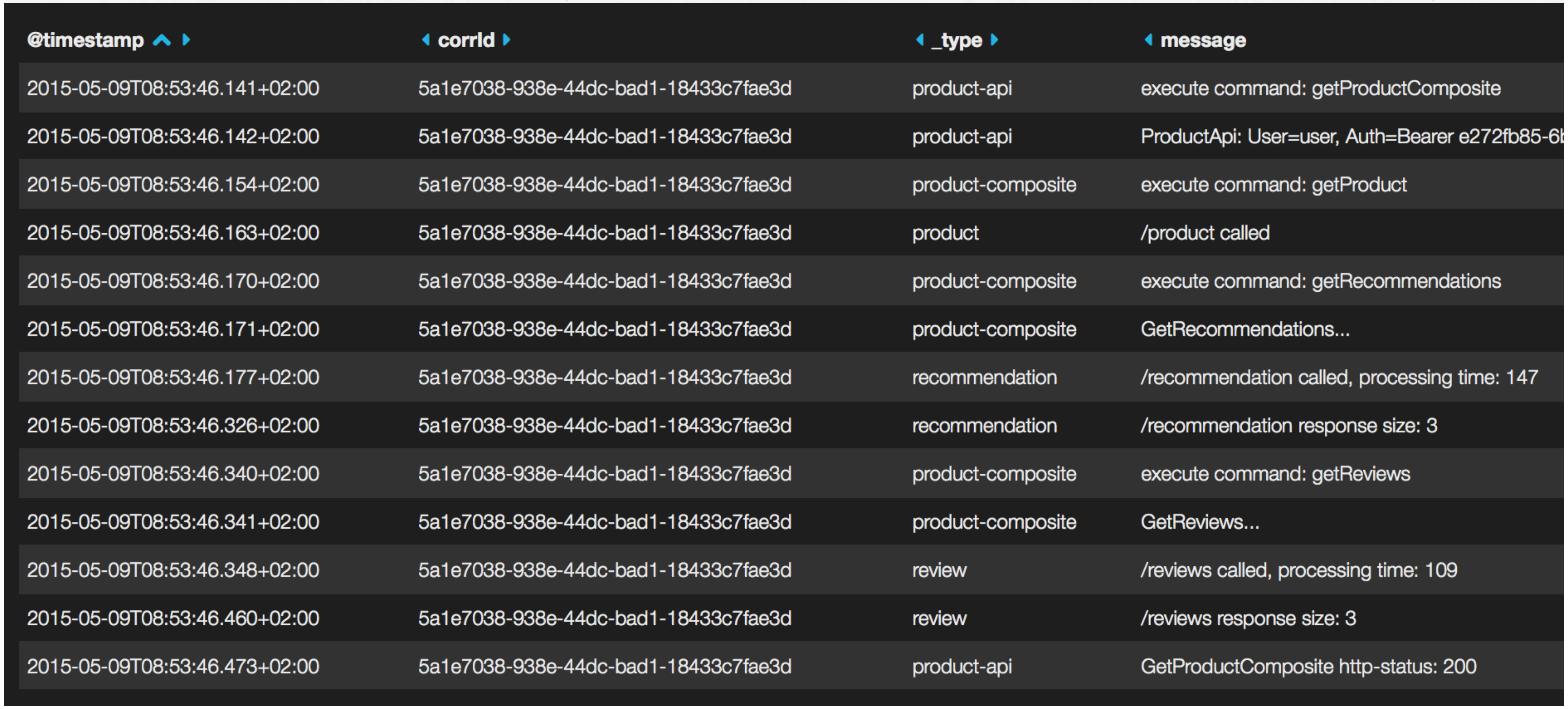
THE DISCOVERY SERVER



Instances currently registered with Eureka

Application	AMIs	Availability Zones	Status
EDGESERVER	n/a (1)	(1)	UP (1) - 172.17.0.70:edgeserver:b74a3b6279298de049546f78f8cde438
PRODUCT	n/a (1)	(1)	UP (1) - 172.17.0.64:product:81409c2245b0135600a481972c9bfef8
PRODUCTAPI	n/a (1)	(1)	UP (1) - 172.17.0.68:productapi:9bb492a65a85c9e2d76e18adec3d5c09
PRODUCTCOMPOSITE	n/a (1)	(1)	UP (1) - 172.17.0.66:productcomposite:afb55f6fb35cd6a1fac33c6e0e1f6cd5
RECOMMENDATION	n/a (1)	(1)	UP (1) - 172.17.0.60:recommendation:56ba137a59ceeb7118f4431b90f76d1a
REVIEW	n/a (1)	(1)	UP (1) - 172.17.0.62:review:3db2f7d0117f6041e87359b6c25b29e6

CENTRALIZED LOG ANALYSIS - KIBANA

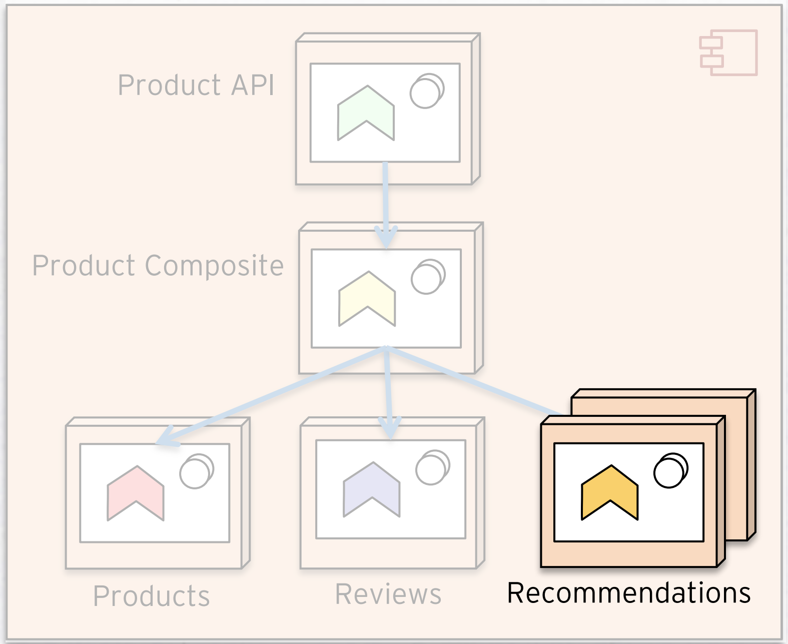


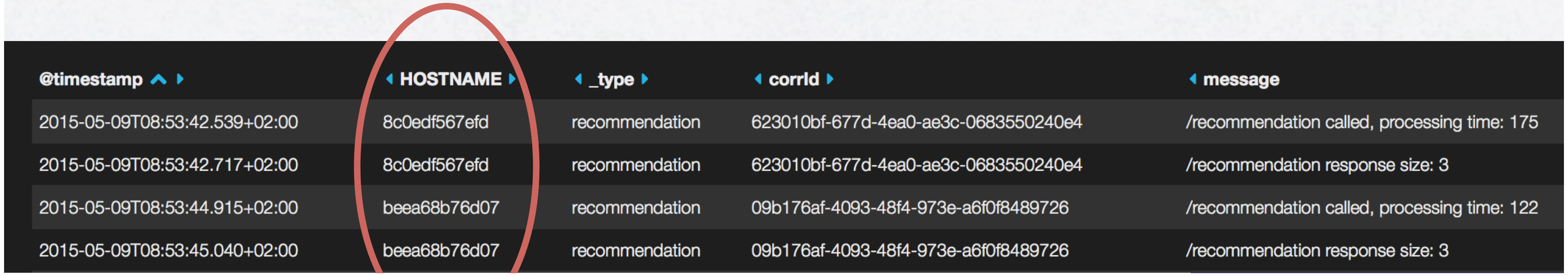
@timestamp	corrId	_type	message
2015-05-09T08:53:46.141+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-api	execute command: getProductComposite
2015-05-09T08:53:46.142+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-api	ProductApi: User=user, Auth=Bearer e272fb85-6
2015-05-09T08:53:46.154+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-composite	execute command: getProduct
2015-05-09T08:53:46.163+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product	/product called
2015-05-09T08:53:46.170+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-composite	execute command: getRecommendations
2015-05-09T08:53:46.171+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-composite	GetRecommendations...
2015-05-09T08:53:46.177+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	recommendation	/recommendation called, processing time: 147
2015-05-09T08:53:46.326+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	recommendation	/recommendation response size: 3
2015-05-09T08:53:46.340+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-composite	execute command: getReviews
2015-05-09T08:53:46.341+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-composite	GetReviews...
2015-05-09T08:53:46.348+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	review	/reviews called, processing time: 109
2015-05-09T08:53:46.460+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	review	/reviews response size: 3
2015-05-09T08:53:46.473+02:00	5a1e7038-938e-44dc-bad1-18433c7fae3d	product-api	GetProductComposite http-status: 200

SCALE UP

- Let’s scale up one of the services

```
$ docker-compose scale rec=2
...
$ docker-compose ps
Name
------
api_1
rec_1
rec_2
...
```

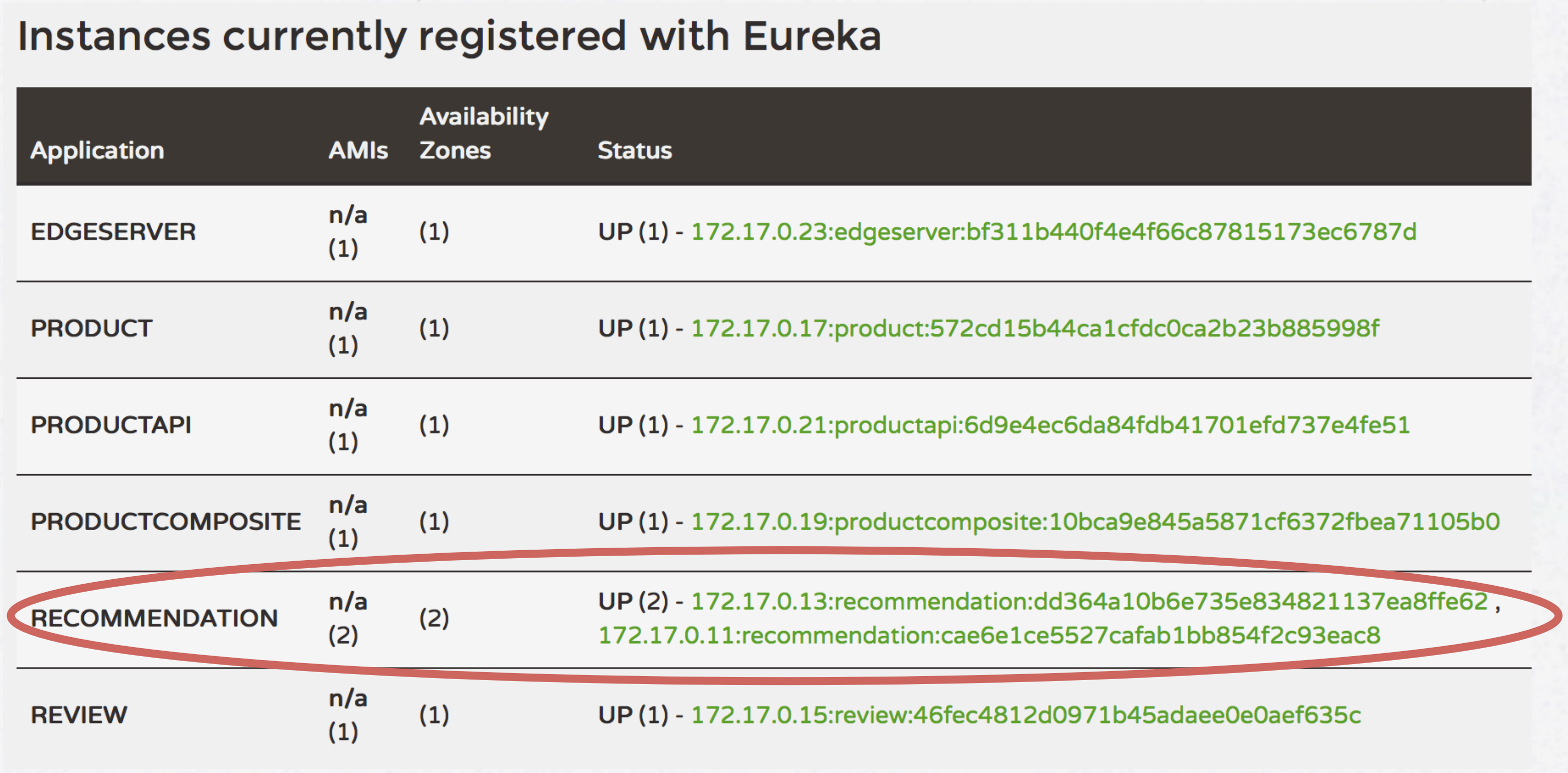




@timestamp	HOSTNAME	_type	corrId	message
2015-05-09T08:53:42.539+02:00	8c0edf567efd	recommendation	623010bf-677d-4ea0-ae3c-0683550240e4	/recommendation called, processing time: 175
2015-05-09T08:53:42.717+02:00	8c0edf567efd	recommendation	623010bf-677d-4ea0-ae3c-0683550240e4	/recommendation response size: 3
2015-05-09T08:53:44.915+02:00	beea68b76d07	recommendation	09b176af-4093-48f4-973e-a6f0f8489726	/recommendation called, processing time: 122
2015-05-09T08:53:45.040+02:00	beea68b76d07	recommendation	09b176af-4093-48f4-973e-a6f0f8489726	/recommendation response size: 3

SCALE UP

- The new service instance in the discovery server



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EDGESERVER	n/a (1)	(1)	UP (1) - 172.17.0.23:edgeserver:bf311b440f4e4f66c87815173ec6787d
PRODUCT	n/a (1)	(1)	UP (1) - 172.17.0.17:product:572cd15b44ca1cfdc0ca2b23b885998f
PRODUCTAPI	n/a (1)	(1)	UP (1) - 172.17.0.21:productapi:6d9e4ec6da84fdb41701efd737e4fe51
PRODUCTCOMPOSITE	n/a (1)	(1)	UP (1) - 172.17.0.19:productcomposite:10bca9e845a5871cf6372fbea71105b0
RECOMMENDATION	n/a (2)	(2)	UP (2) - 172.17.0.13:recommendation:dd364a10b6e735e834821137ea8ffe62 , 172.17.0.11:recommendation:cae6e1ce5527cafab1bb854f2c93eac8
REVIEW	n/a (1)	(1)	UP (1) - 172.17.0.15:review:46fec4812d0971b45adaee0e0aef635c

CALL THE API

- Get an access token from the OAuth Authentication Server

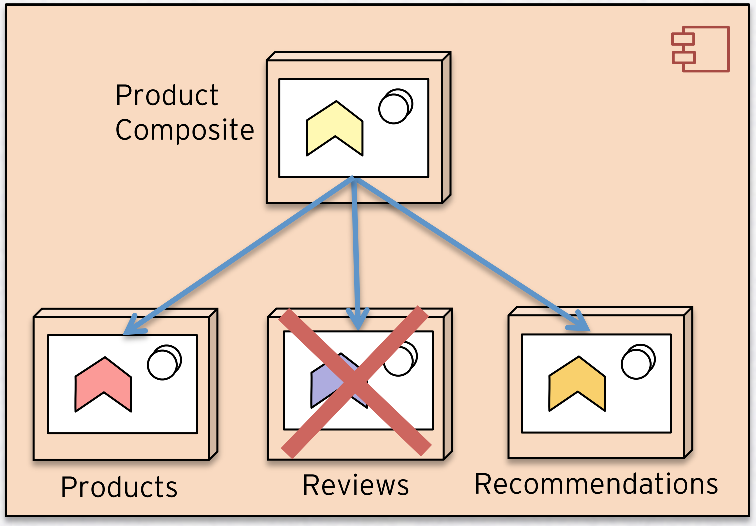
```
$ curl -s acme:acmesecret@docker:9999/uaa/oauth/token  \
    -d grant_type=password -d client_id=acme \
    -d username=user       -d password=password | jq .

{"access_token": "e5863174-6a25-4e4d-9fe0-32532a842d88", ...}
```

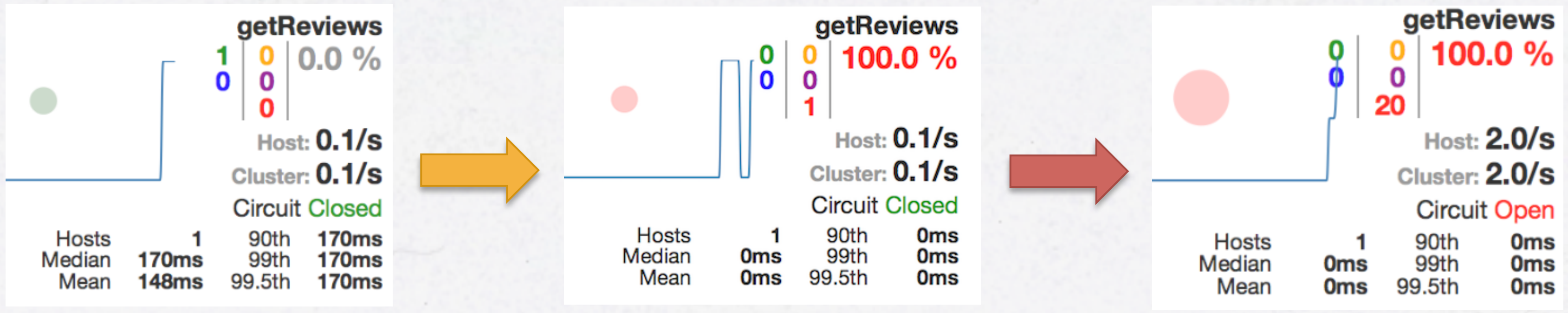
- Call the API with the access token

```
$ curl -s 'http://docker:8765/api/product/12345' \
    -H  "Authorization: Bearer $TOKEN"| jq .
{
  "productId": 12345, "name": "name", ...
  "recommendations": [ {...}, {...}, {...} ],
  "reviews": [ {...}, {...}, {...} ]
}
```

CIRCUIT BREAKER

- Introduce an error
  - The review service stops to response, requests just hangs until requests timeout
- Try out
- Force the Circuit to open
  - Coming requests will fast-fail, i.e. not wait for the timeout!





```
getReviews
1  0 | 0.0 %
0  0
   0
Host: 0.1/s
Cluster: 0.1/s
Circuit Closed
Hosts      1     90th   170ms
Median  170ms    99th   170ms
Mean    148ms  99.5th   170ms
```

```
getReviews
0  0 | 100.0 %
0  0
   1
Host: 0.1/s
Cluster: 0.1/s
Circuit Closed
Hosts      1     90th   0ms
Median   0ms     99th   0ms
Mean     0ms   99.5th   0ms
```

```
getReviews
0  0 | 100.0 %
0  0
  20
Host: 2.0/s
Cluster: 2.0/s
Circuit Open
Hosts      1     90th   0ms
Median   0ms     99th   0ms
Mean     0ms   99.5th   0ms
```

CIRCUIT BREAKER

- Normal calls (circuit **closed**):

```
$ curl 'http://docker:8765/api/product/12345' ...
 {"productId": ..., "recommendations": [...], "reviews":[...]}
0.398 ms
```

- Calls with a few timeouts (circuit still **closed**):

```
$ curl 'http://docker:8765/api/product/12345' ...
 {"productId": ..., "recommendations": [...], "reviews":null}
3.295 ms
```

- Calls with a lot of timeouts (circuit **open**, i.e. it will **fast-fail**):

```
$ curl 'http://docker:8765/api/product/12345' ...
 {"productId": ..., "recommendations": [...], "reviews":null}
0.239 ms
```

CALLISTA
— ENTERPRISE —

...WHAT WE DIDN'T HAVE TIME TO TALK ABOUT (THIS TIME)

- The CAP theorem and distributed systems, eventual consistency...
- Conway's law requires organizational changes
- Continuous Delivery, a pre-requisite for large-scale use of microservices
- How to apply TDD for microservices?

SUMMARY

- Microservices use new solutions to old problems regarding
  - Scalability, resilience, release cycles
- Microservices is about splitting up monoliths in units of independently replaceable and upgradeable components
- Uses infrastructure for scaling out on many small servers
  - In cloud or on premises
- New advanced, battle-proven and open source tools for handling challenges with microservices
  - Netflix OSS, Spring Cloud and the ELK stack

Q&A

- Want to know more?
  - Try out our blog series: Building Microservices (http://goo.gl/bSg5mC)