MICROSERVICES I PRAKTIKEN

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

MAGNUS LARSSON

2015.05.21 | CALLISTAENTERPRISE.SE

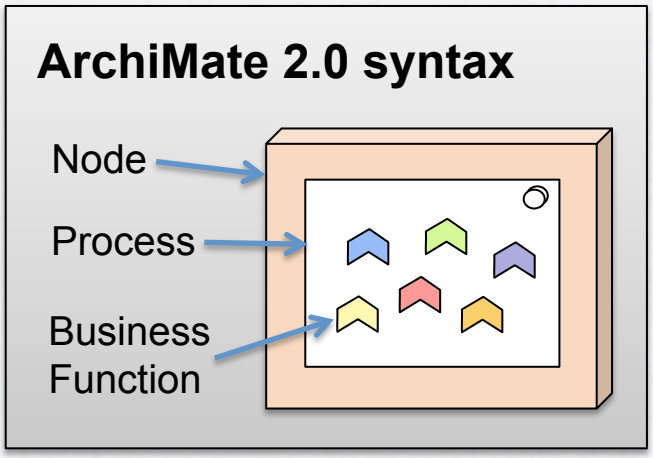
CALLISTA
— ENTERPRISE —

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!

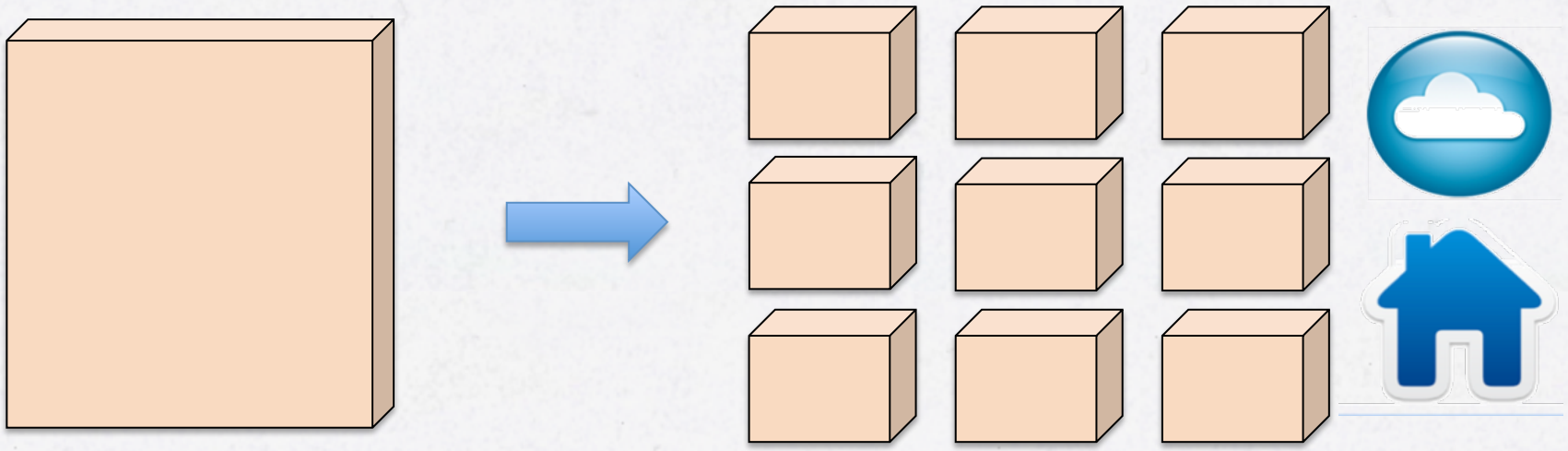


HISTORY OF MICROSERVICES

- 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)

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

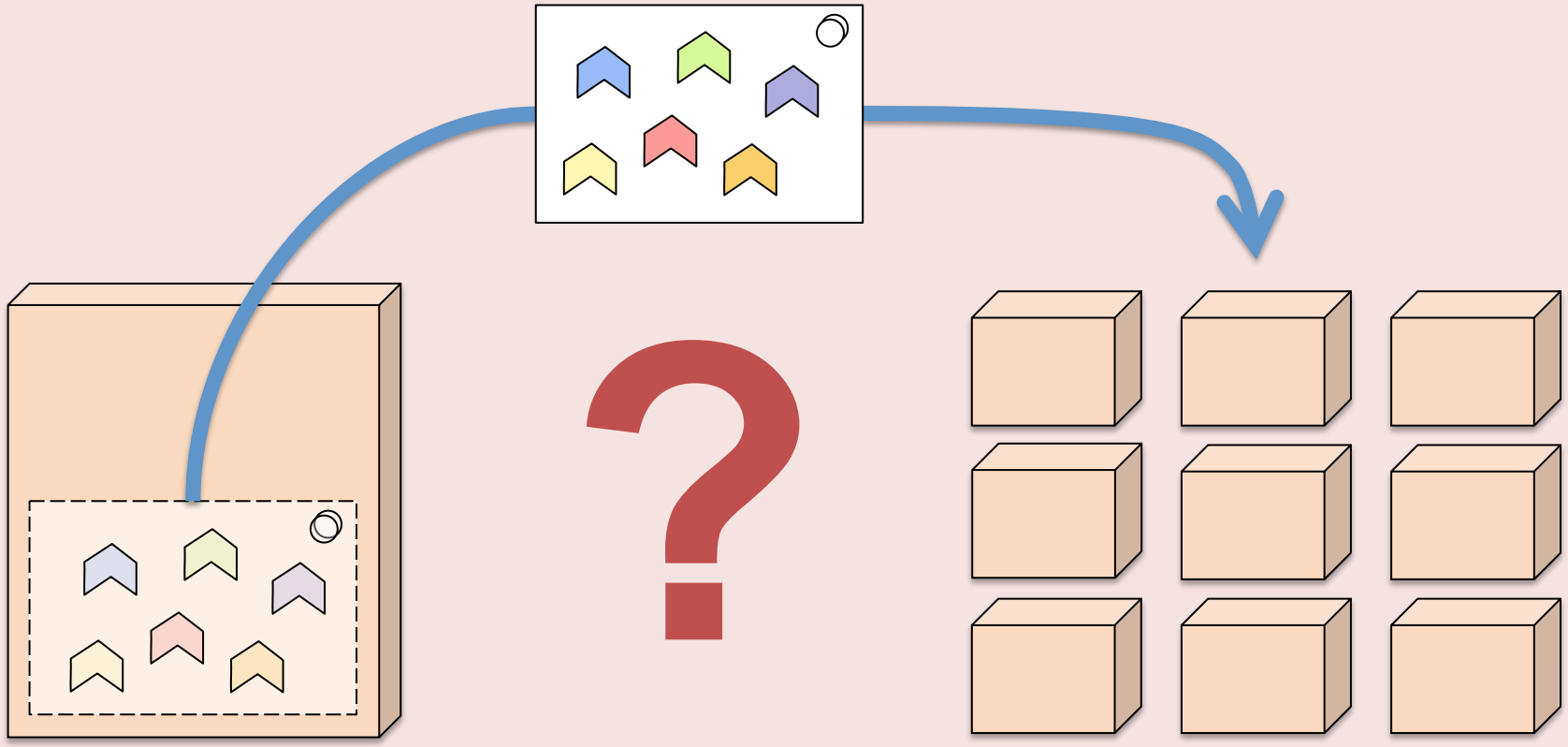


NEW SOLUTIONS TO OLD PROBLEMS

- *Cloud computing* makes it easier to manage many small servers
  - **IaaS: Infrastructure as a Service**
    - » Deliver virtual servers
    - » E.g. Amazon EC2, Microsoft 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* ?
    - » Windows Server Containers on its way (http://goo.gl/ZmEkTS)!

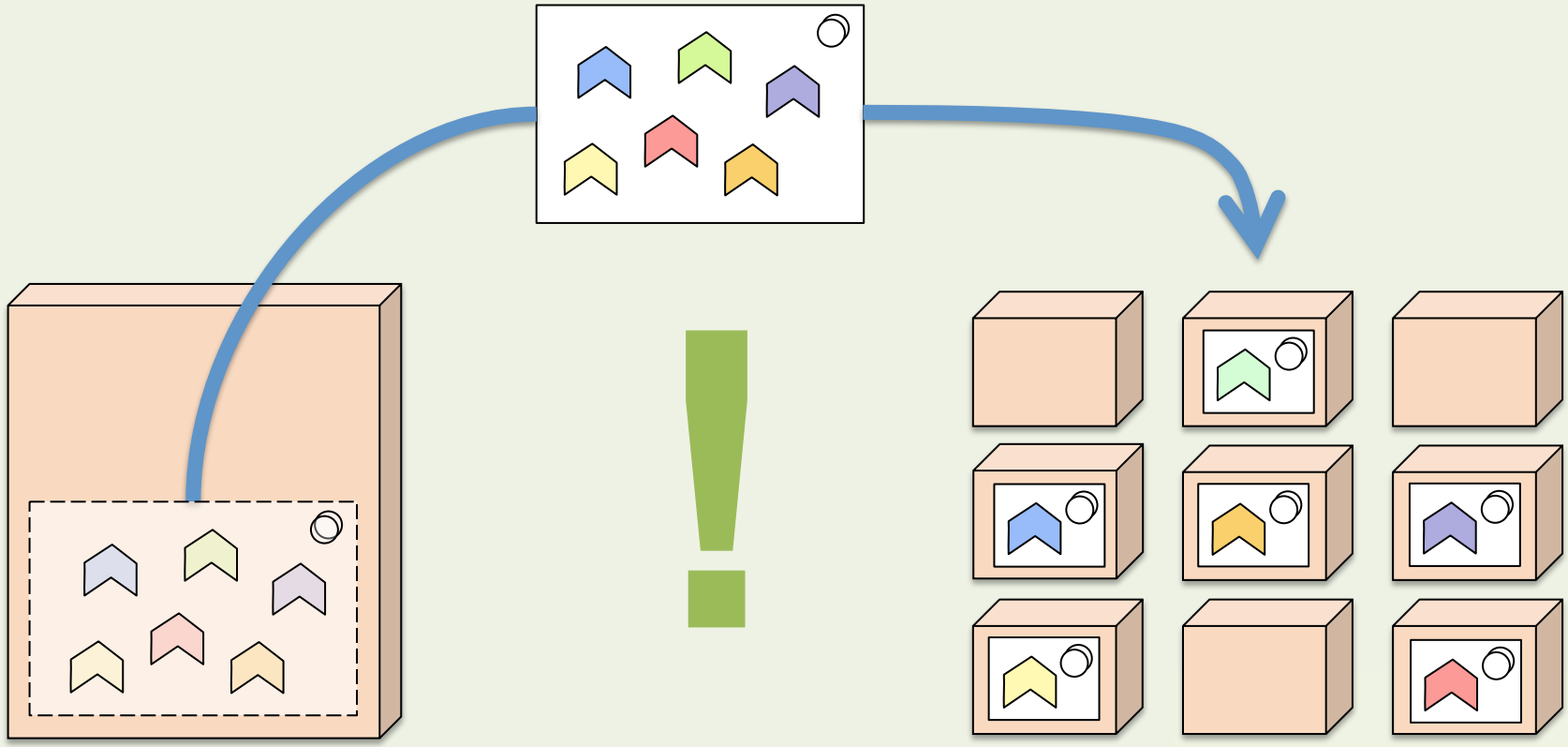
NEW SOLUTIONS TO OLD PROBLEMS

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



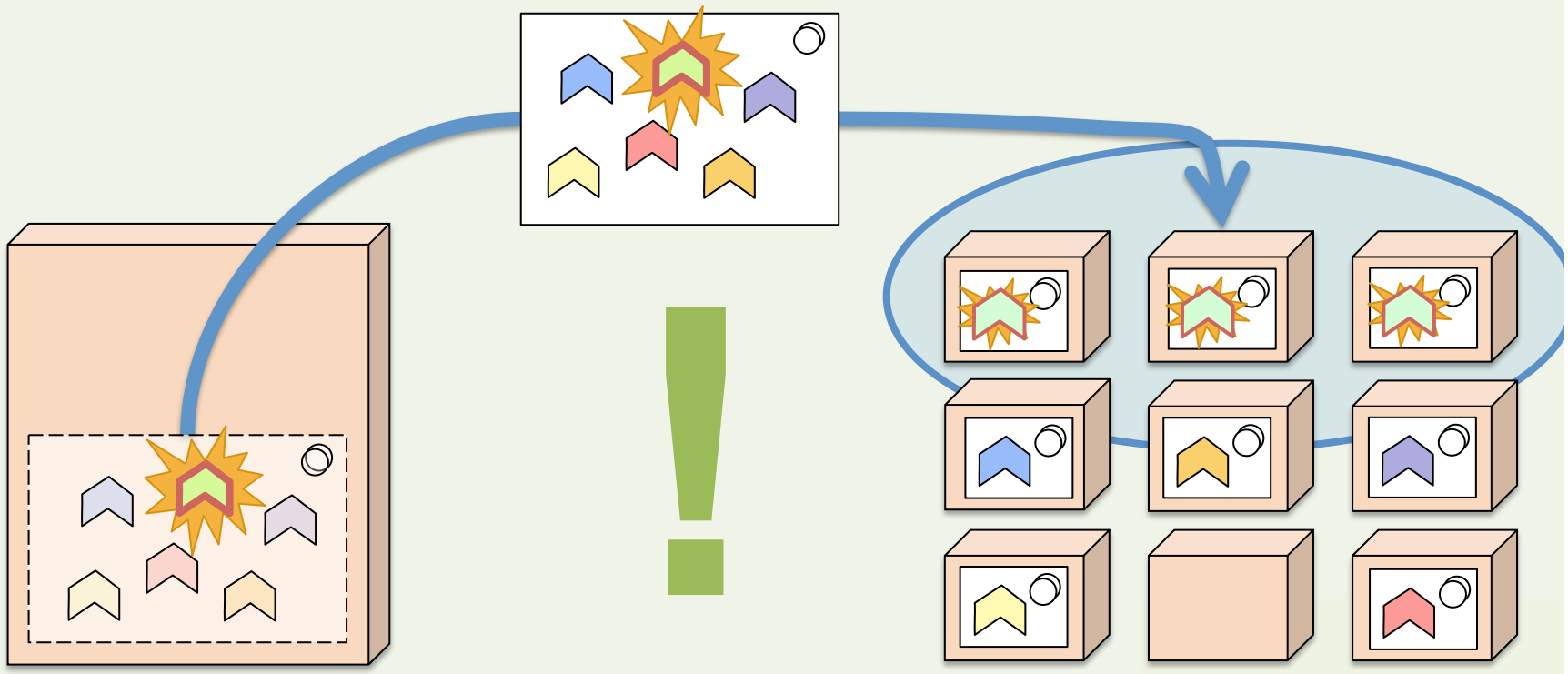
NEW SOLUTIONS TO OLD PROBLEMS

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



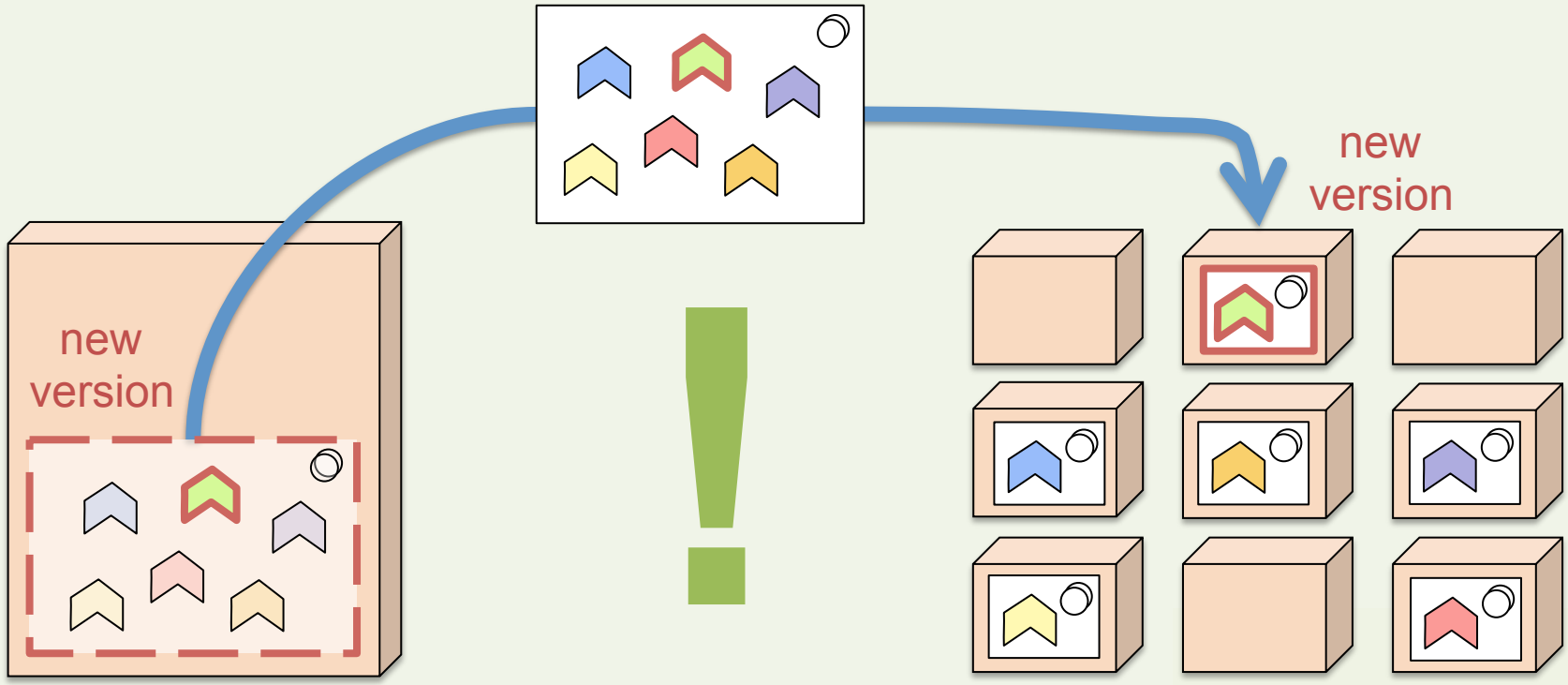
NEW SOLUTIONS TO OLD PROBLEMS

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



NEW SOLUTIONS TO OLD PROBLEMS

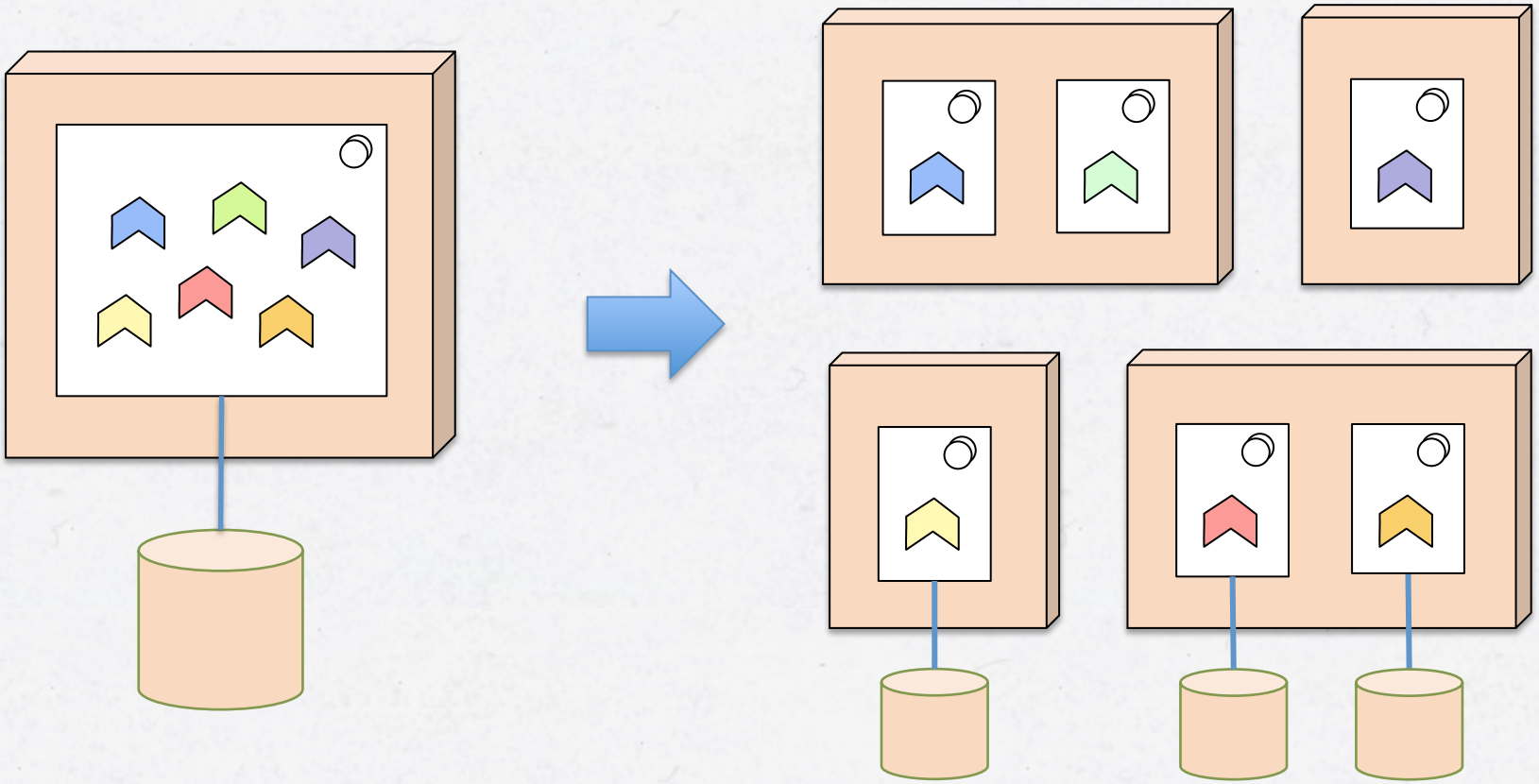
- Shorter release cycles
  - So much easier to update or replace a microservice compared to a monolith



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?



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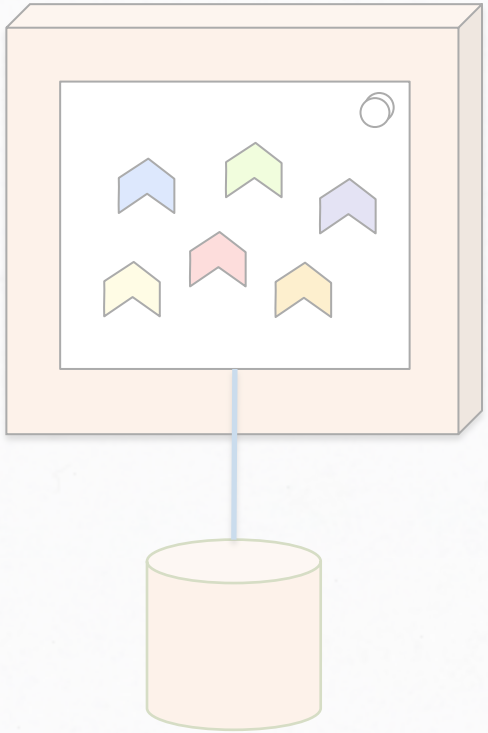
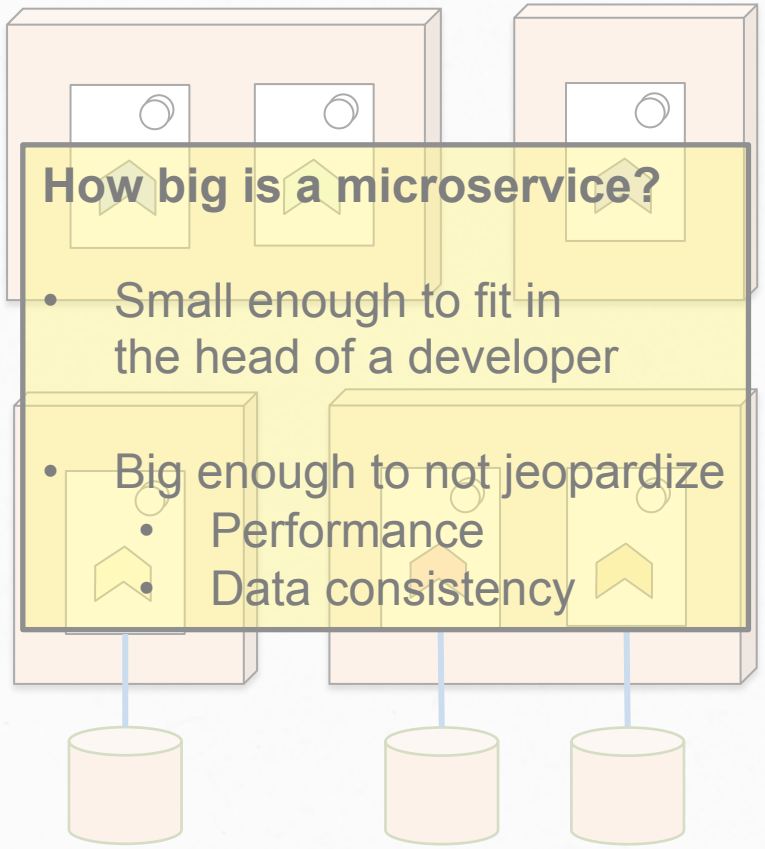
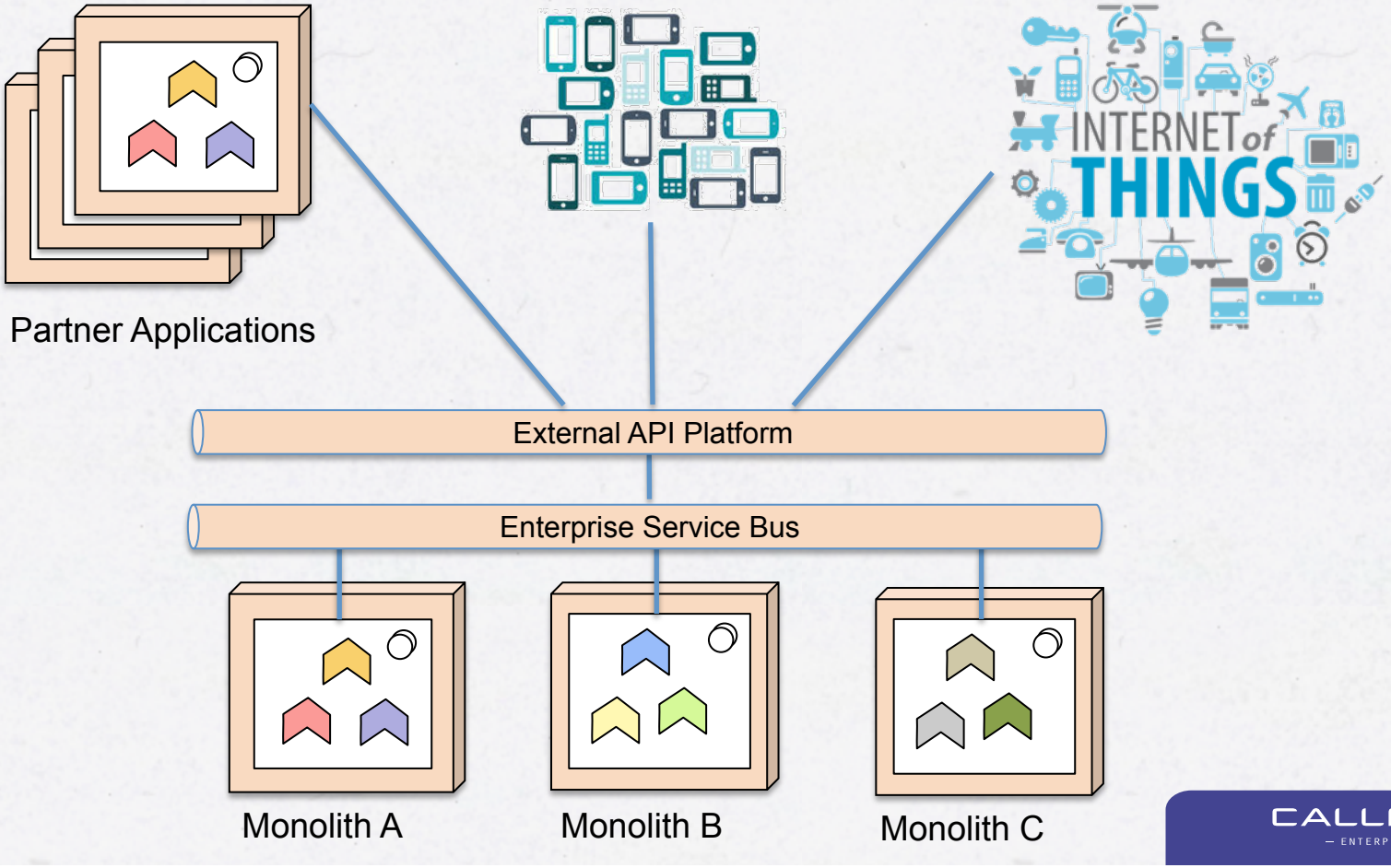




How big is a microservice?

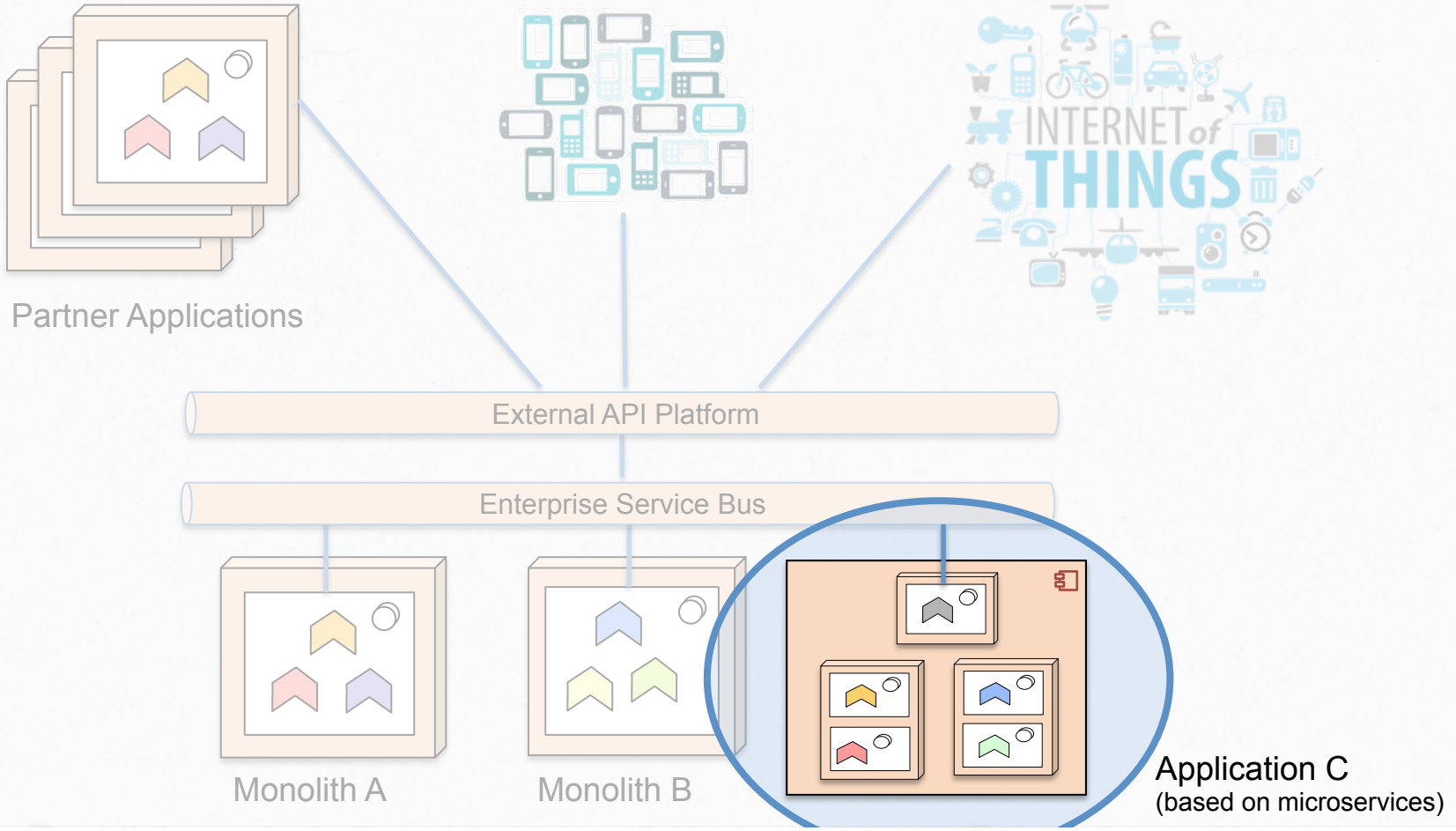
- Small enough to fit in the head of a developer
- Big enough to not jeopardize
  - Performance
  - Data consistency

HOW DOES MICROSERVICES FIT INTO AN EXISTING SYSTEM LANDSCAPE?



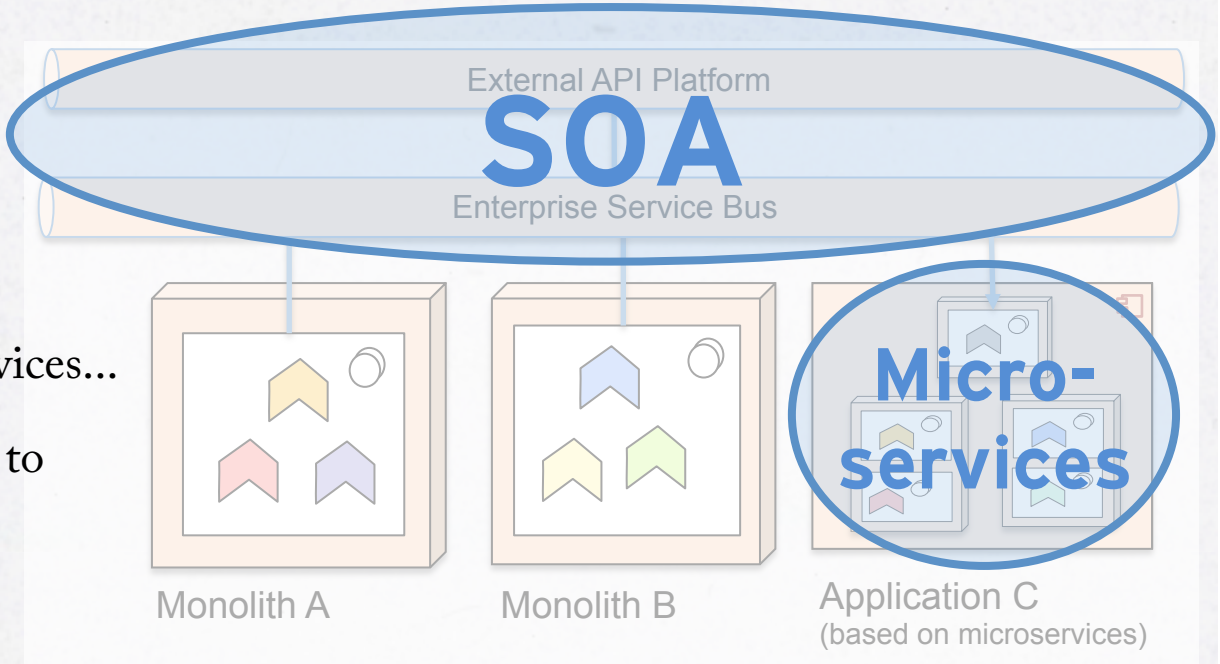
CALLISTA
— ENTERPRISE —

HOW DOES MICROSERVICES FIT INTO AN EXISTING SYSTEM LANDSCAPE?



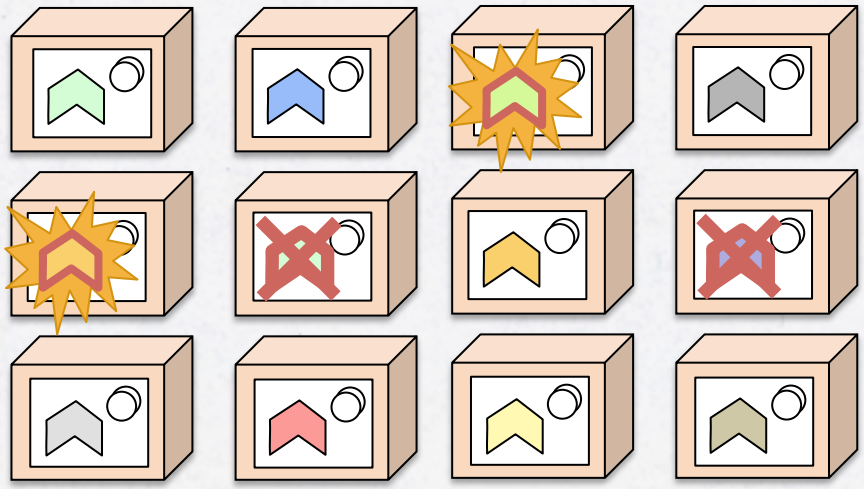
WHAT'S A MICROSERVICE?

- 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...



NEW CHALLENGES WITH MICROSERVICES

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

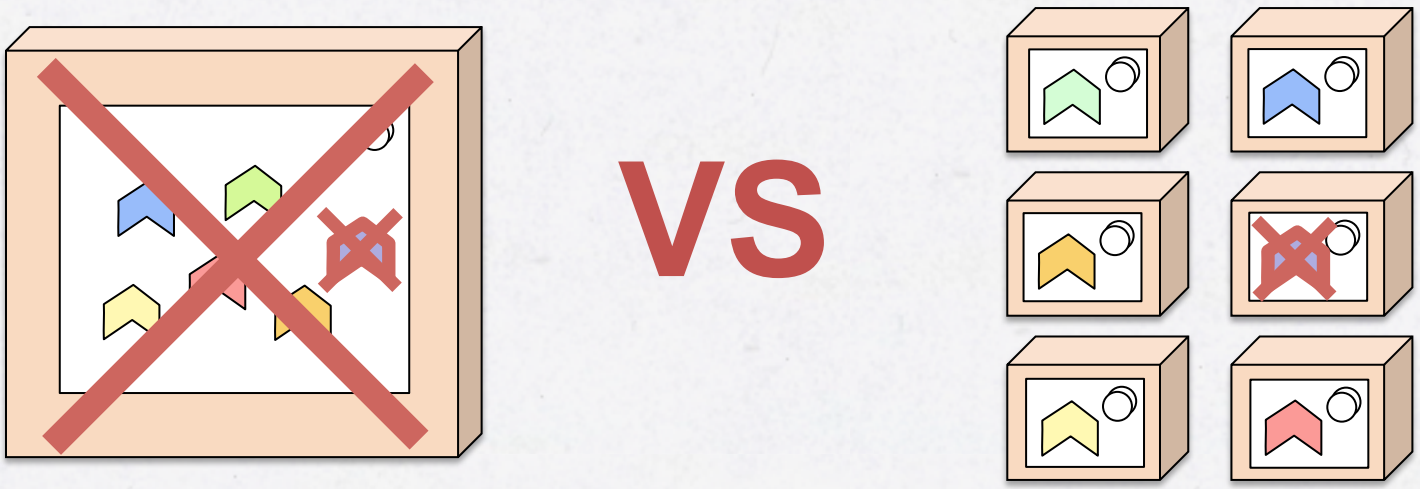


NEW CHALLENGES WITH MICROSERVICES

- What went wrong???

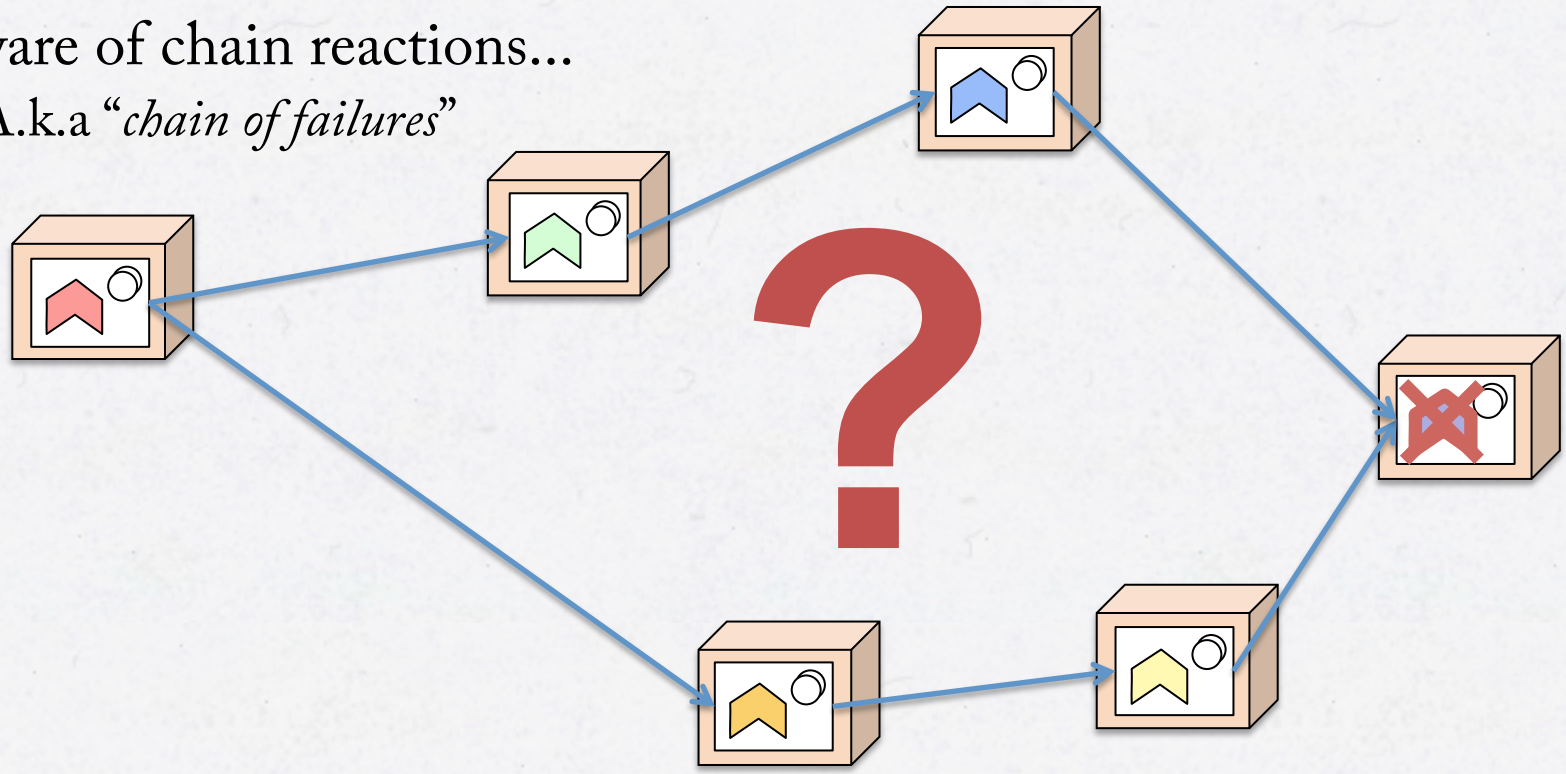
NEW CHALLENGES WITH MICROSERVICES - RESILIENCE

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



NEW CHALLENGES WITH MICROSERVICES - RESILIENCE

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



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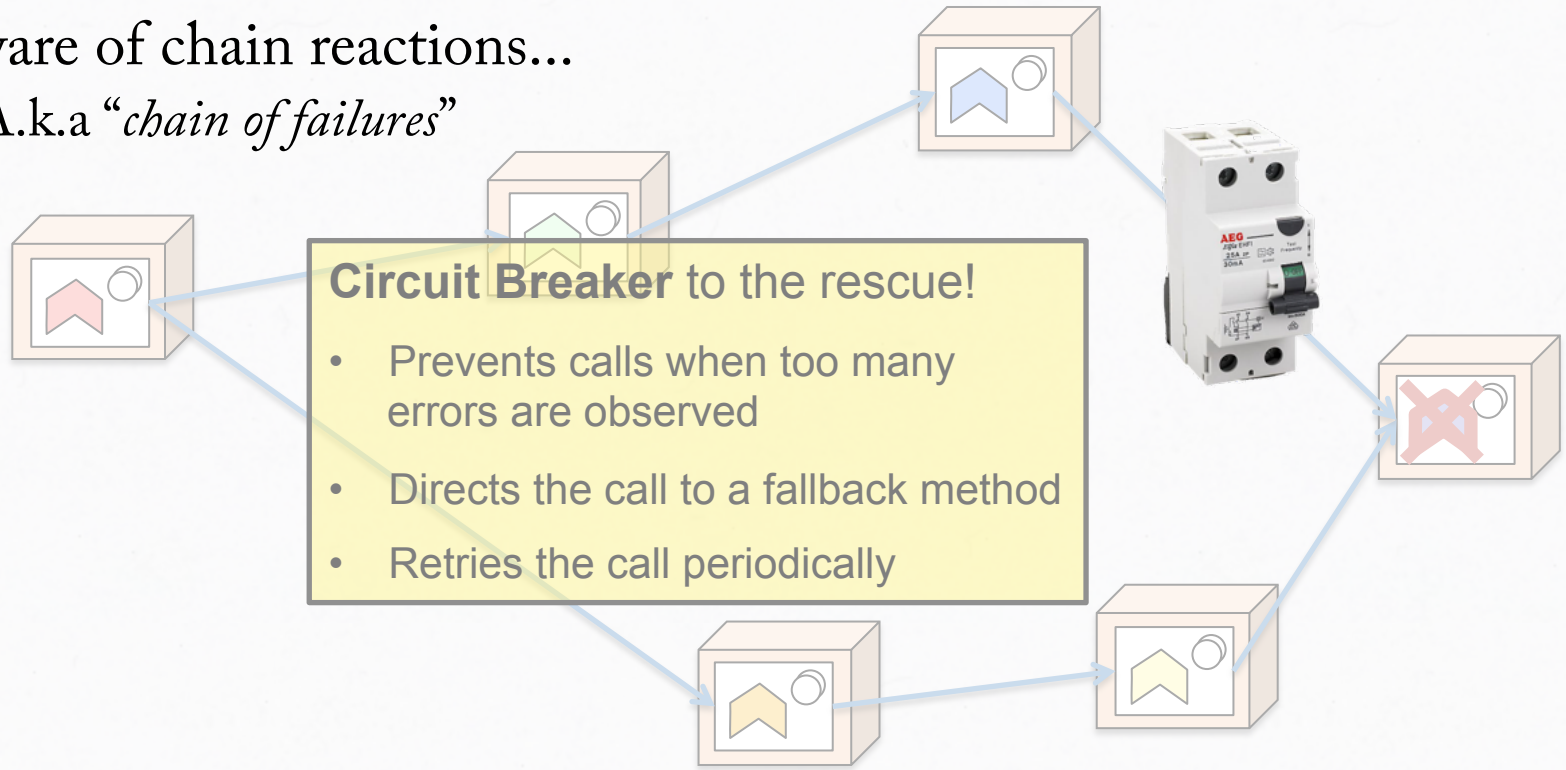

NEW CHALLENGES WITH MICROSERVICES

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

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Open Source tools to the rescue

NETFLIX OSS

SPRING CLOUD

elasticsearch.

logstash

Kibana

  3. **Protecting external API's**
     - » Secure external API's using OAuth 2.0

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...

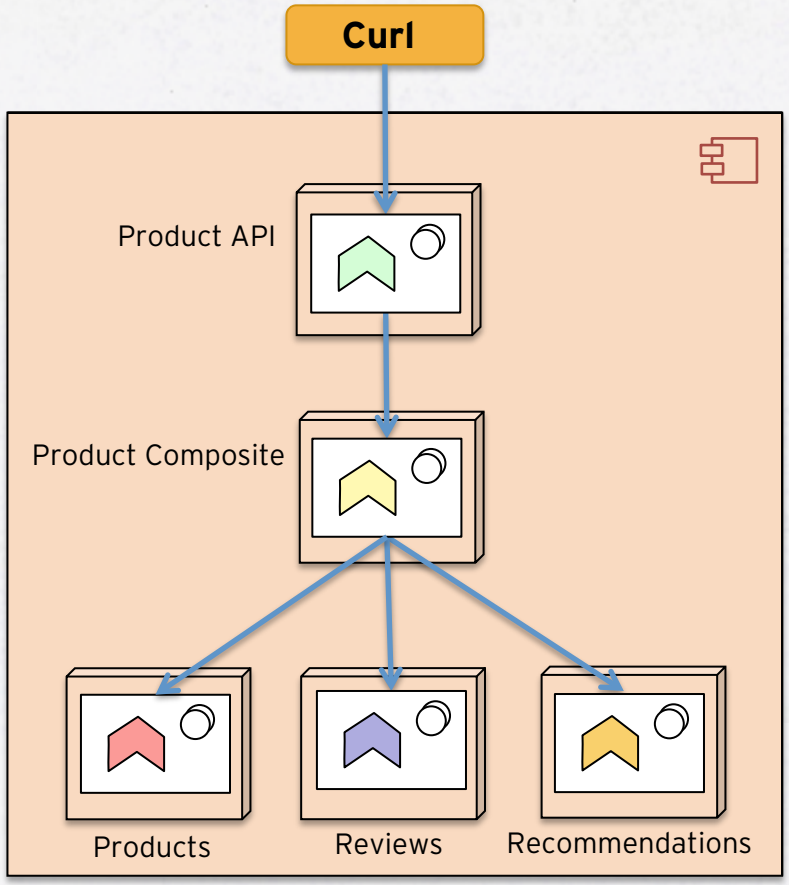
SPRING CLOUD

- 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

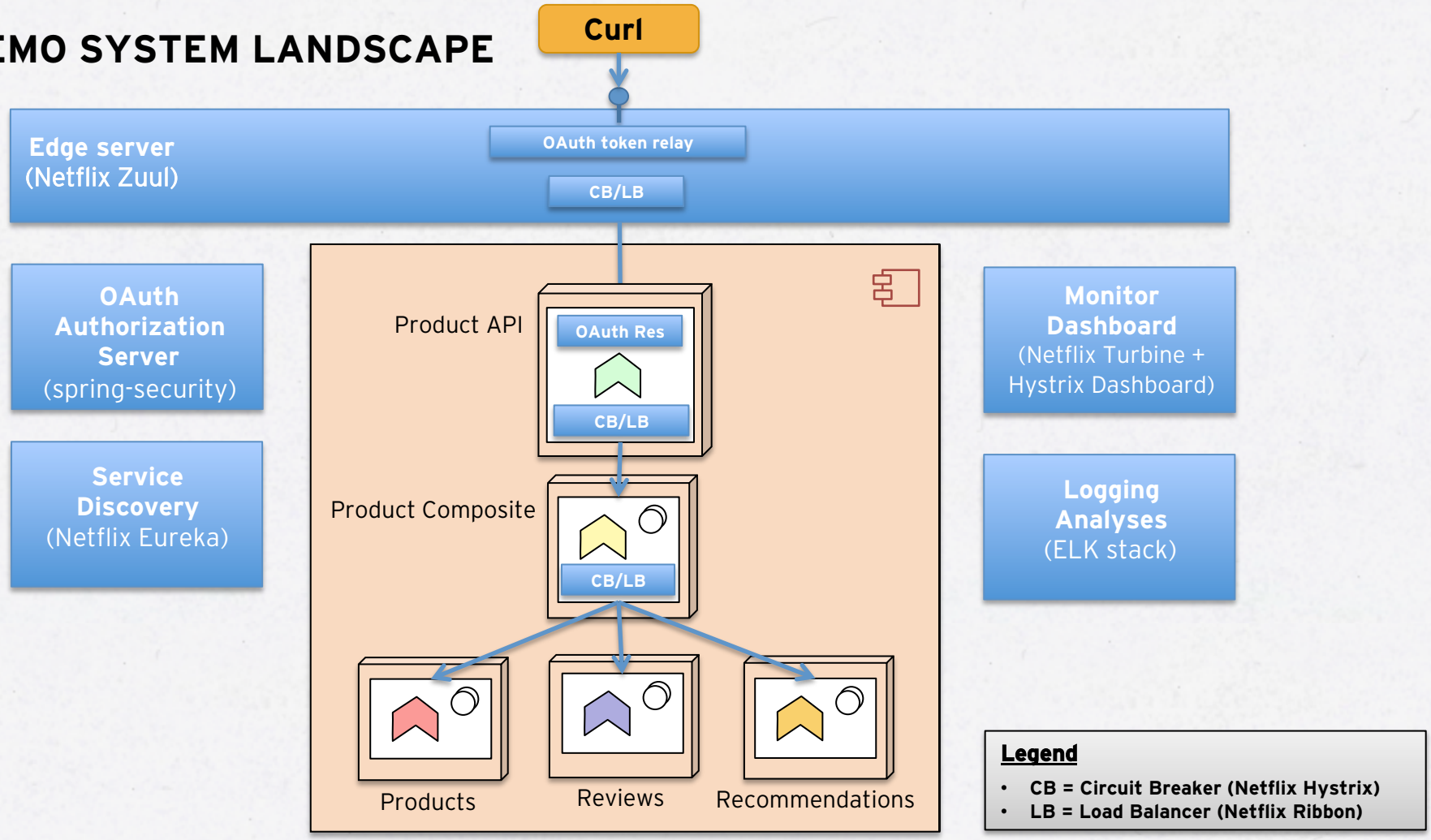
- The ELK stack (https://goo.gl/aCHlhN)
  - **E**lasticsearch, **L**ogstash and **K**ibana
  - Used for centralized log analyses

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



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

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$ 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

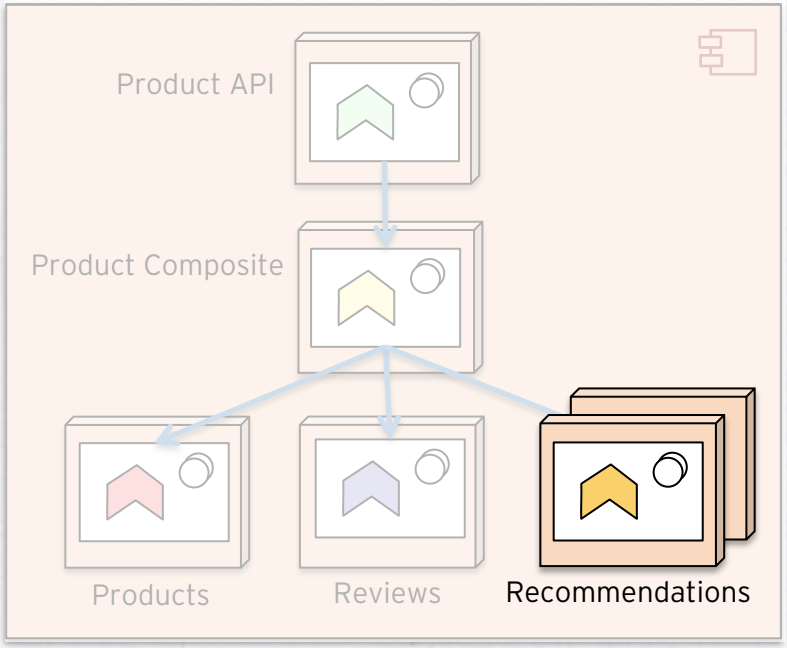
CENTRALIZED LOG ANALYSIS - KIBANA

@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 e272fb85-6b
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

Instances currently registered with Eureka

Application	AMIs	Availability Zones	Status
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

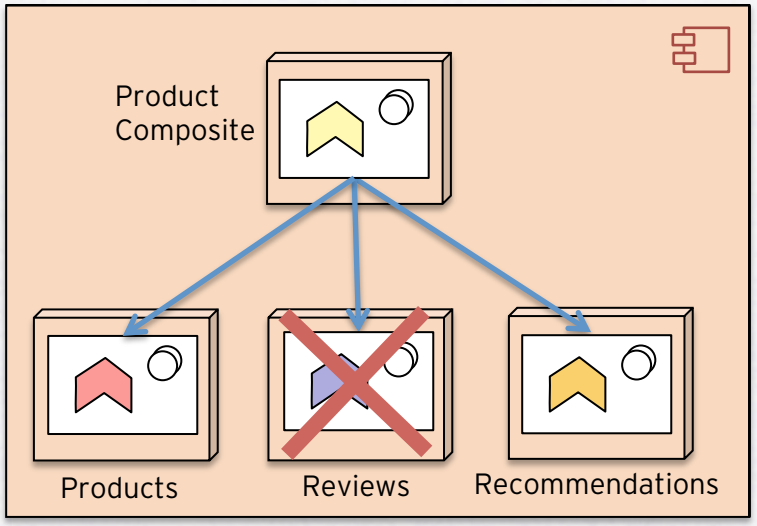
```
$ curl -s acme:acmesecret@docker:9999/uaa/oauth/token  \
    -d grant_type=password -d client_id=acme \
    -d username=user       -d password=password | jq .

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

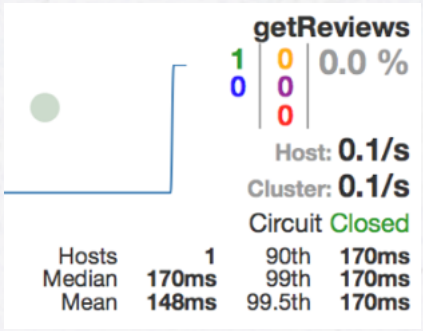
- Call the API with the access token

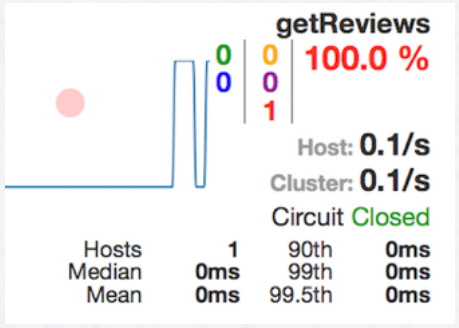
```
$ curl -s 'http://docker:8765/api/product/12345' \
    -H  "Authorization: Bearer $TOKEN"| jq .
{
  "productId": 12345, "name": "name", ...
  "recommendations": [ {...}, {...}, {...} ],
  "reviews": [ {...}, {...}, {...} ]
}
```

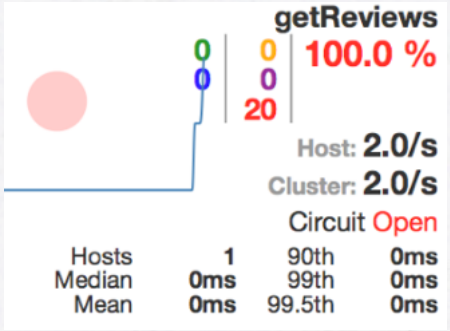
CIRCUIT BREAKER

- 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!









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
```

...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
- Building microservices, try out our blog series (http://goo.gl/6nYXCD)
- How to apply TDD for microservices?
- Configuration of microservices
- When to apply microservices?
    - See blog posts by Sam Newman and Martin Fowler (http://goo.gl/e6A5Zb, http://goo.gl/ifKBmb)

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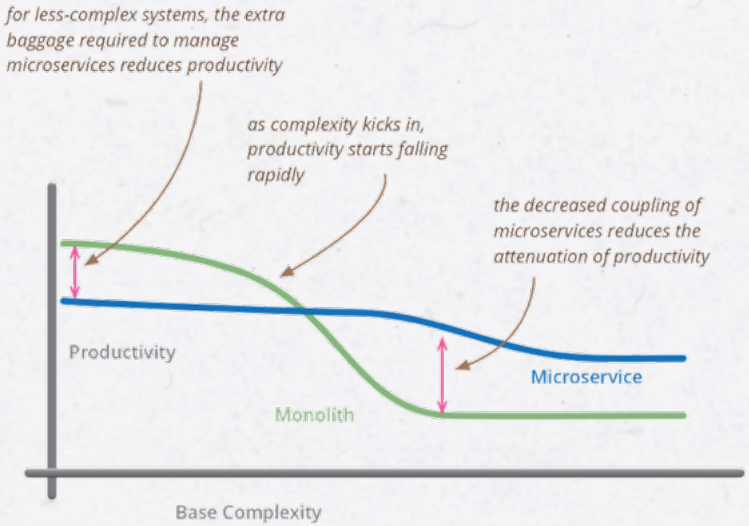

Source: http://goo.gl/ifKBmb

but remember the skill of the team will outweigh any monolith/microservice choice

- When to apply microservices?
  - See blog posts by Sam Newman and Martin Fowler (http://goo.gl/e6A5Zb, http://goo.gl/ifKBmb)

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

WHAT TO DO NEXT?

- Short term:
  - Cherry pick specific components to address current problems, e.g.
    - » the ELK stack for improved log analyses
    - » a Circuit Breaker for improved resilience
  - Familiarize yourself with the microservices architecture
- Mid term:
  - Assess your application portfolio and identify pain points
  - Perform a pilot project with one prioritized application
- Long term:
  - Establish a strategic plan for microservices
  - Fully implement and deploy microservices for one application

Q&A