SDEC15
SOFTWARE DEVELOPMENT & EVOLUTION CONFERENCE 2015

Think Small
An Introduction to Microservices

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Think Small

An Introduction to Microservices

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IBM

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@markstgodard

- Software Engineer @ IBM

IBM Bluemix

CLOUD FOUNDRY

- Java, Ruby, Go
- Agile / Open Source / Cloud Foundry

- *What are Microservices?*
- *Monolith vs. Microservices*
- *Considerations when implementing Microservices*

Continuous Delivery

What are Microservices?


“Loosely coupled service oriented architecture with bounded contexts”
- Adrian Cockcroft


“Loosely coupled service oriented architecture with bounded contexts”
- Adrian Cockcroft


Small &
Focused
* do one thing and do it well

Independently Deployable

Independently Scalable

Independent Teams

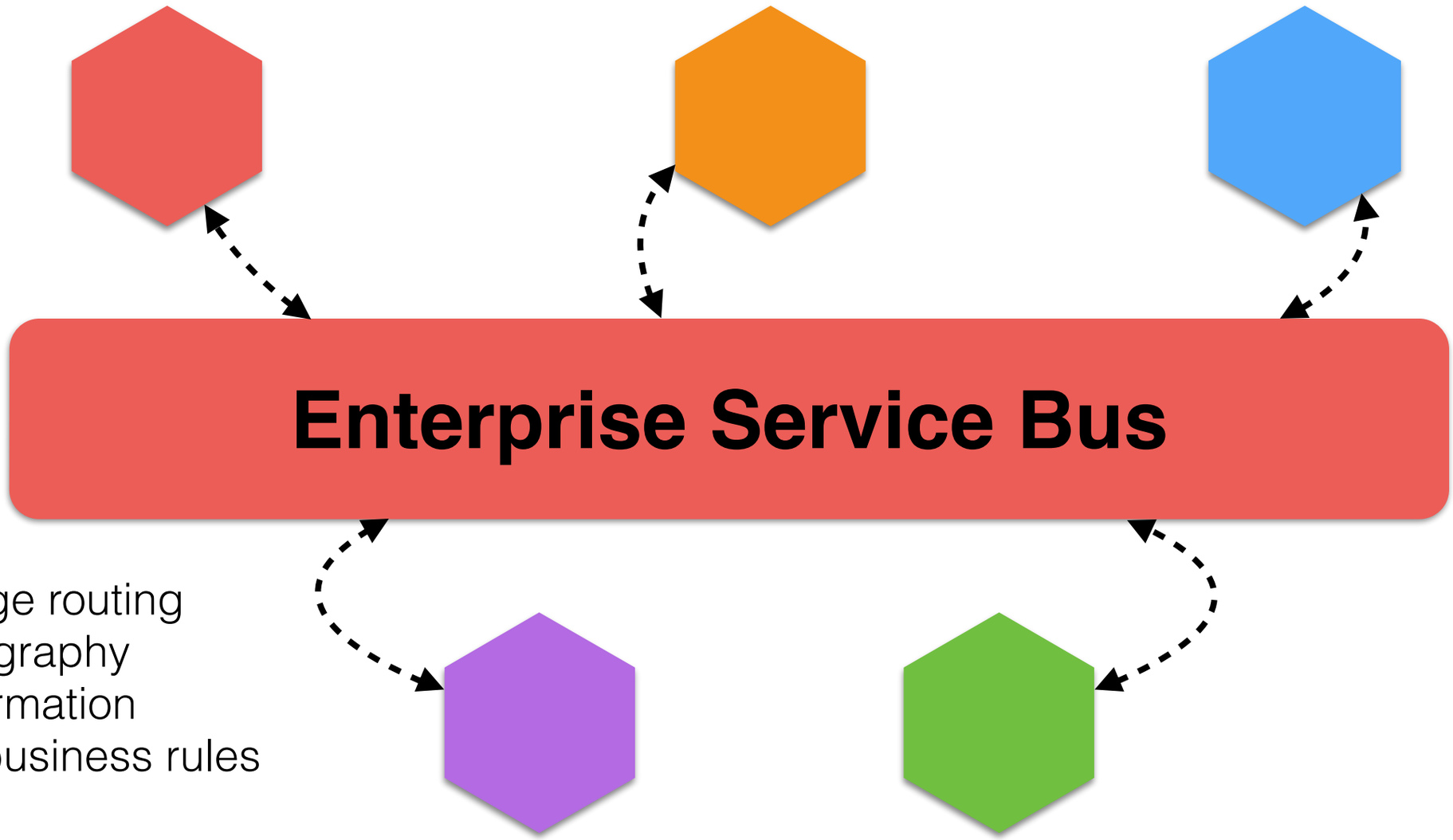
Language Neutral

** expose app functionality using APIs*

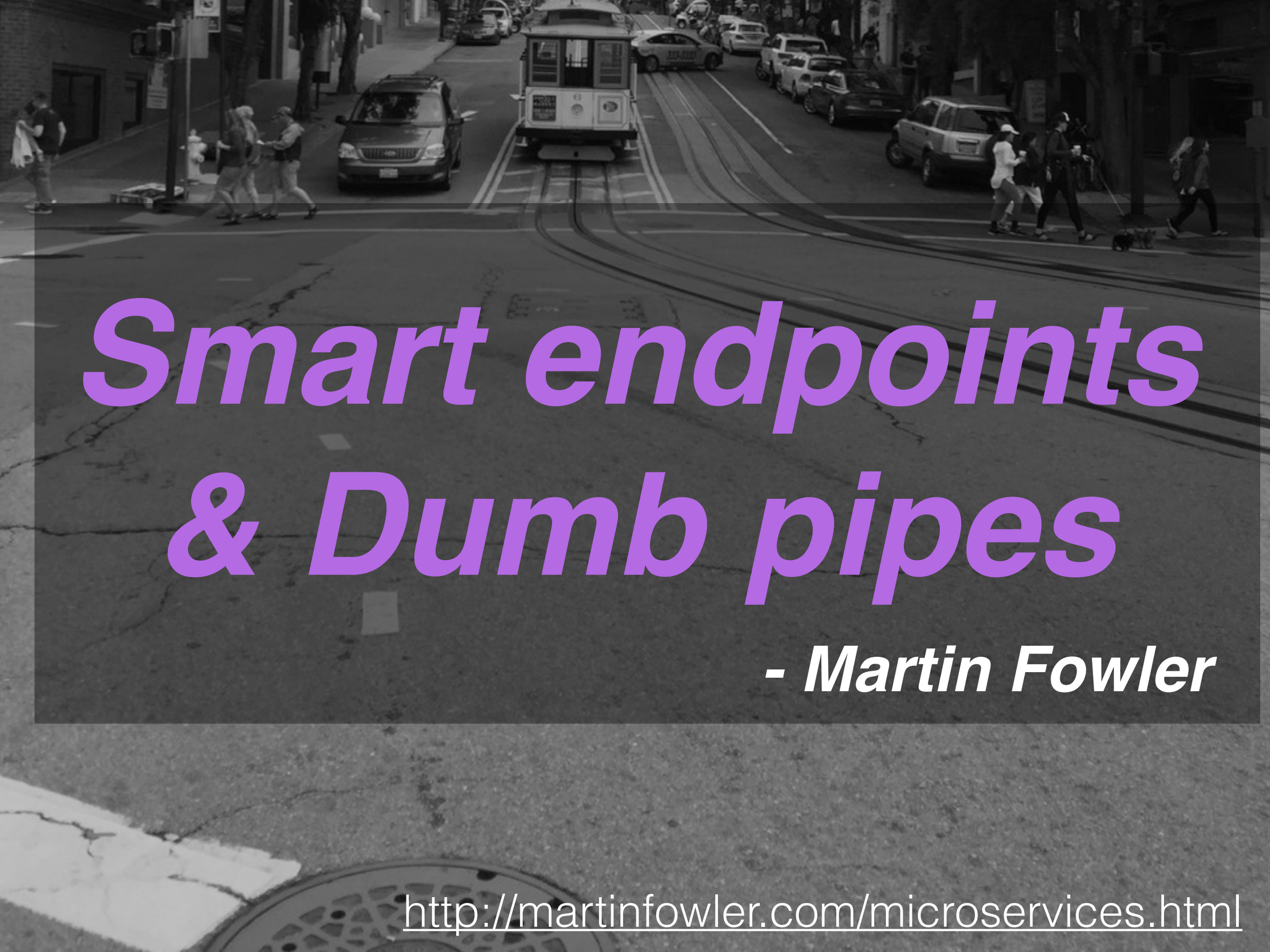
Replaceable

“assume you will build it again” - Jim Benson (this morning)


“Loosely coupled service oriented architecture with bounded contexts”
- Adrian Cockcroft



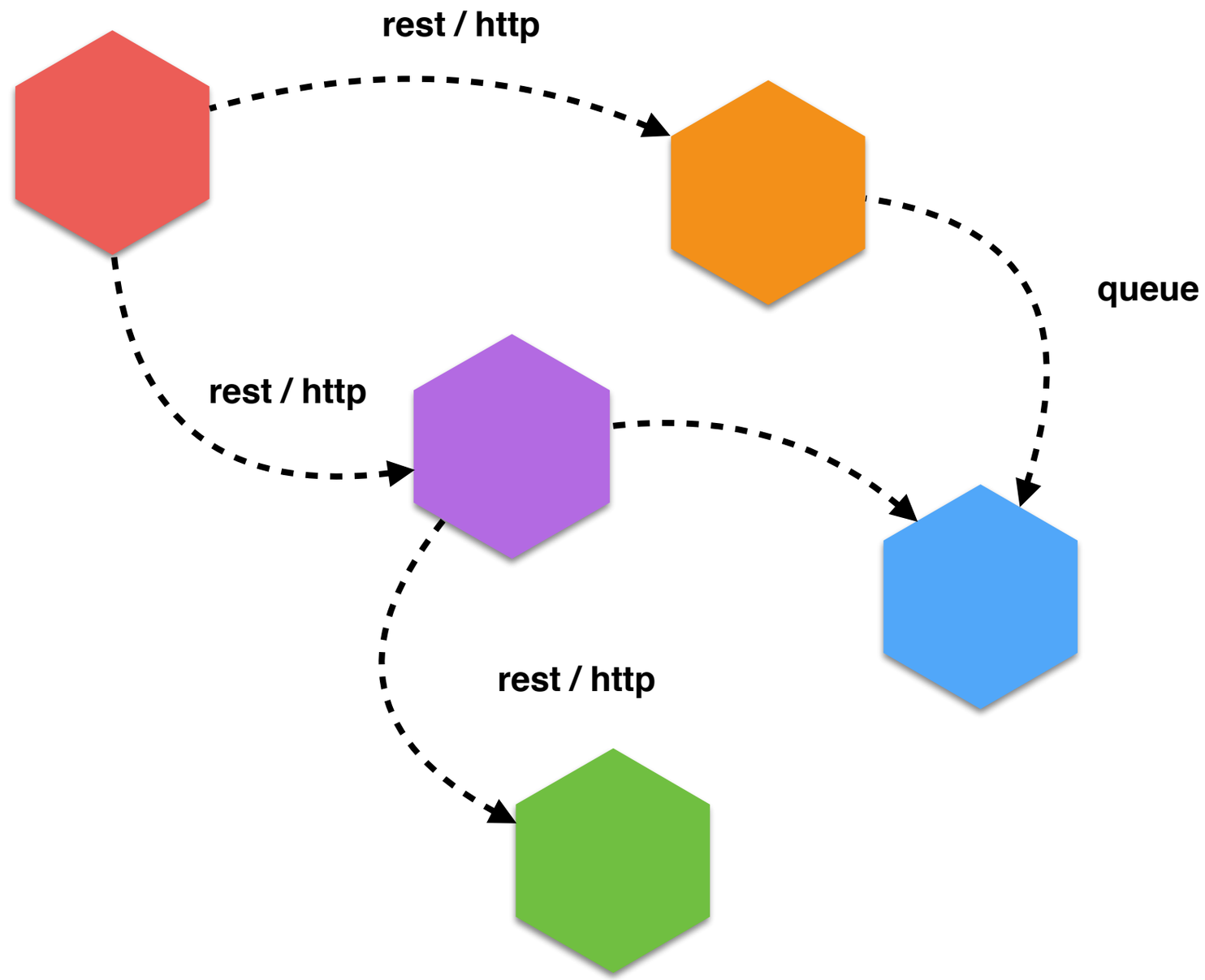
- message routing
- choreography
- transformation
- apply business rules



Smart endpoints & Dumb pipes

- Martin Fowler

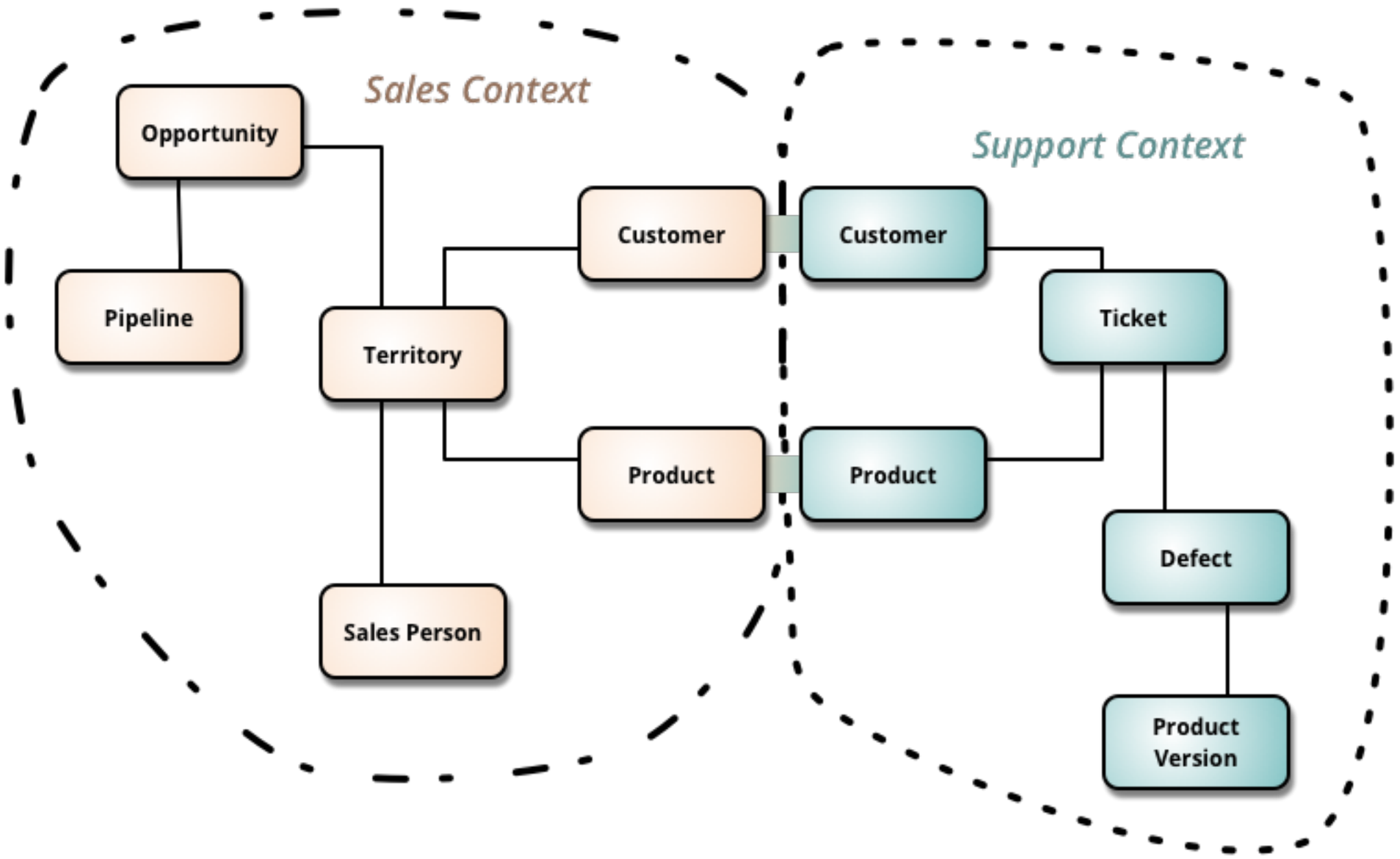
http://martinfowler.com/microservices.html


rest / http
queue
rest / http
rest / http


“Loosely coupled service oriented architecture with bounded contexts”
- Adrian Cockcroft

Business Capability

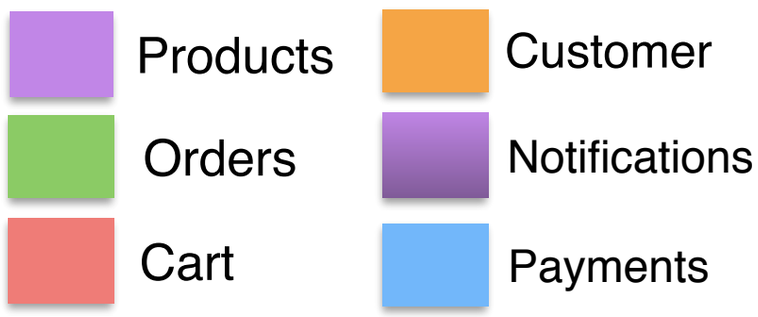
Example Bounded Context



http://martinfowler.com/bliki/BoundedContext.html

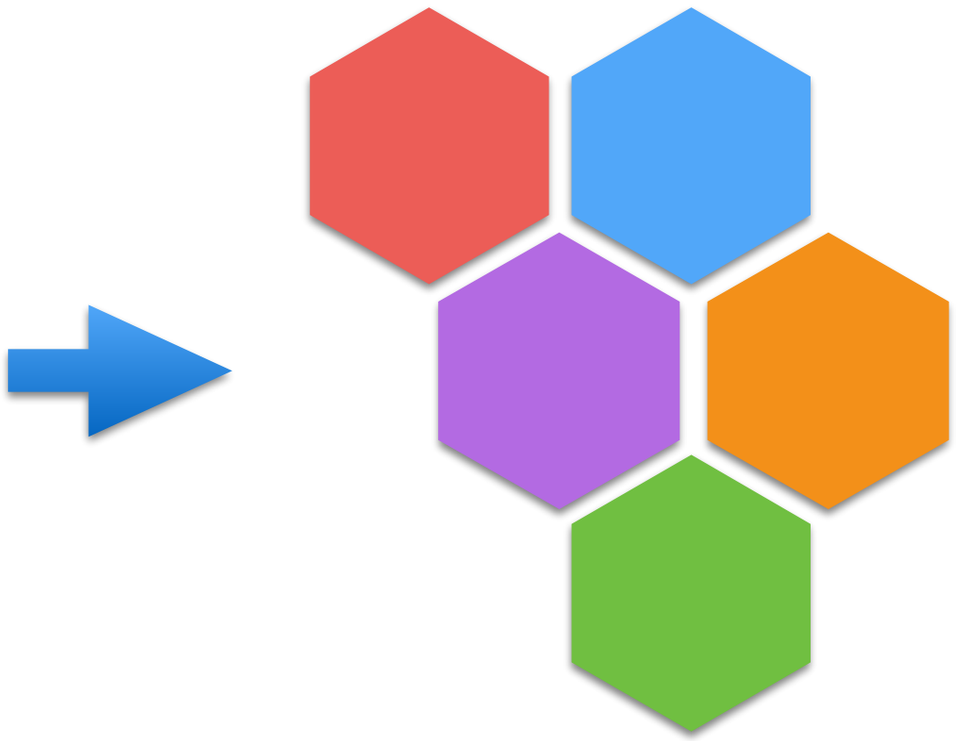
Monolith vs. Microservice

Monolithic



Monolithic

Microservices



Products
Orders
Cart
Customer
Notifications
Payments

Monolith

Products
Orders
Cart
Customer
Notifications
Payments

HTML / HTTP

UI (HTML / Javascript / CSS)

Web Controllers / API

HTTP session

Services / Domain Model

Postgres (DB)

AMQP
(message
queue)

Products
Orders
Cart
Customer
Notifications
Payments

HTML / HTTP

UI (HTML / Javascript / CSS)

Web Controllers / API

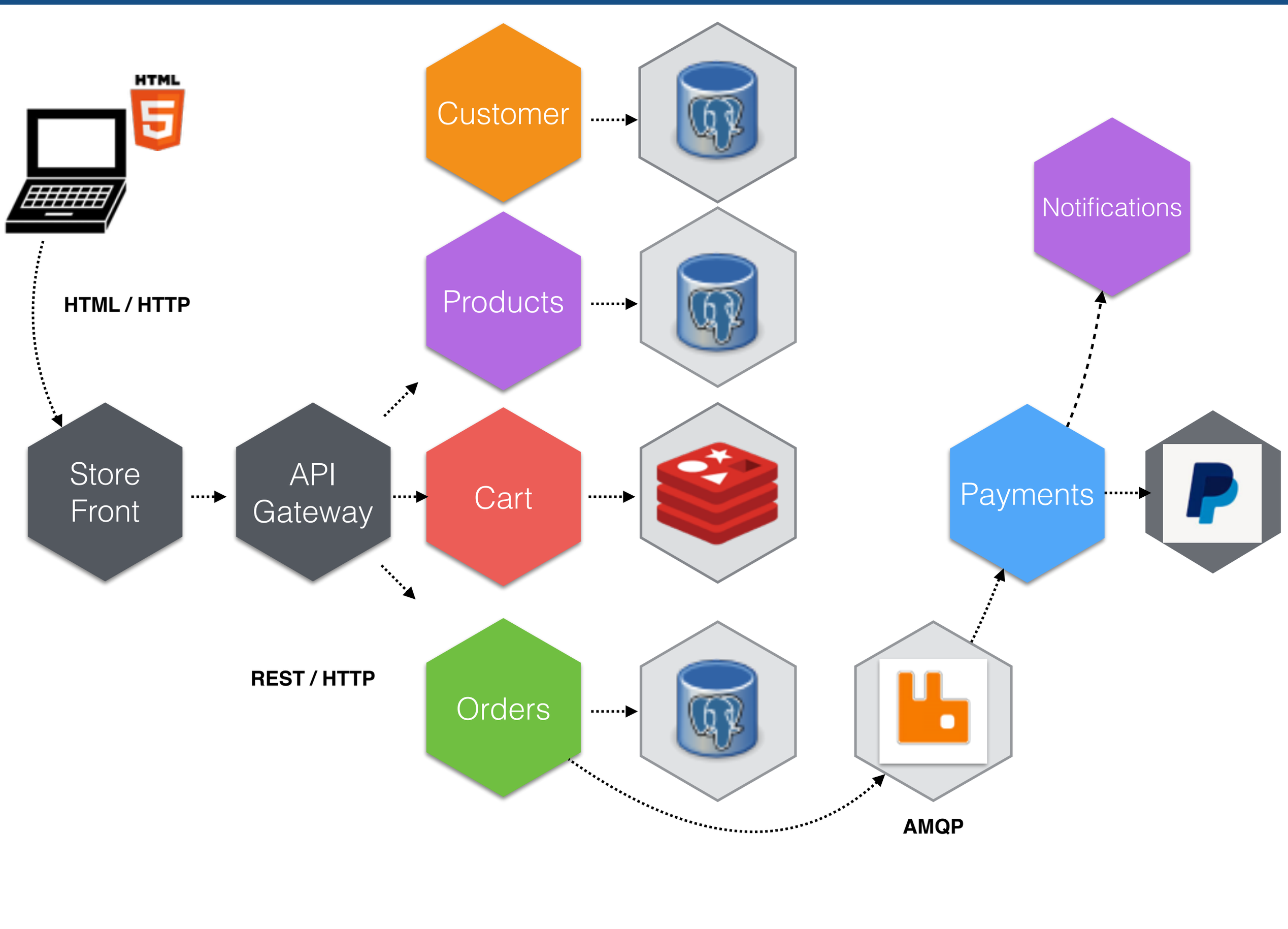
HTTP session

Services / Domain Model

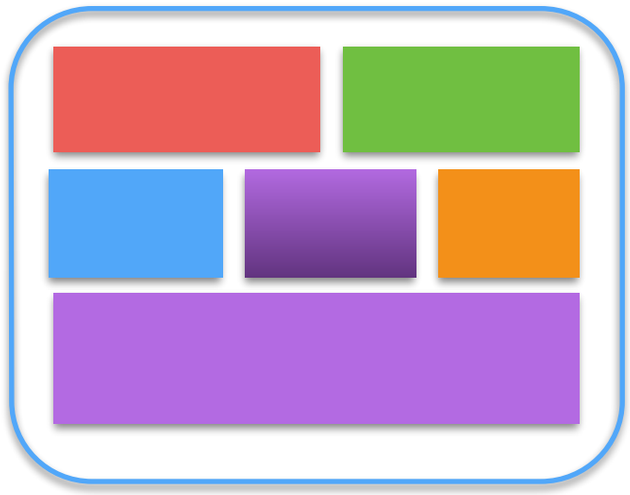
Postgres (DB)

AMQP
(message
queue)

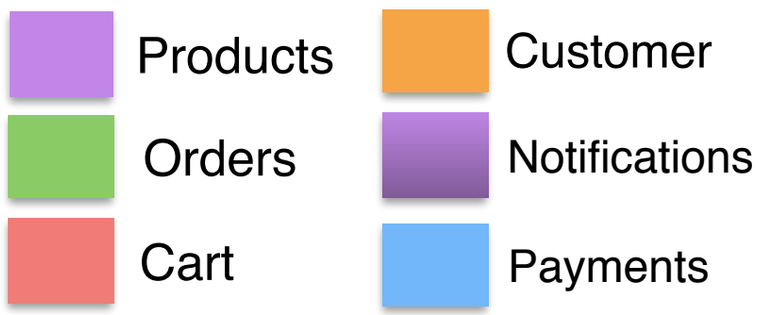
Microservices


HTML
HTML / HTTP
Customer
Products
Notifications
Store Front
API Gateway
Cart
Payments
REST / HTTP
Orders
AMQP

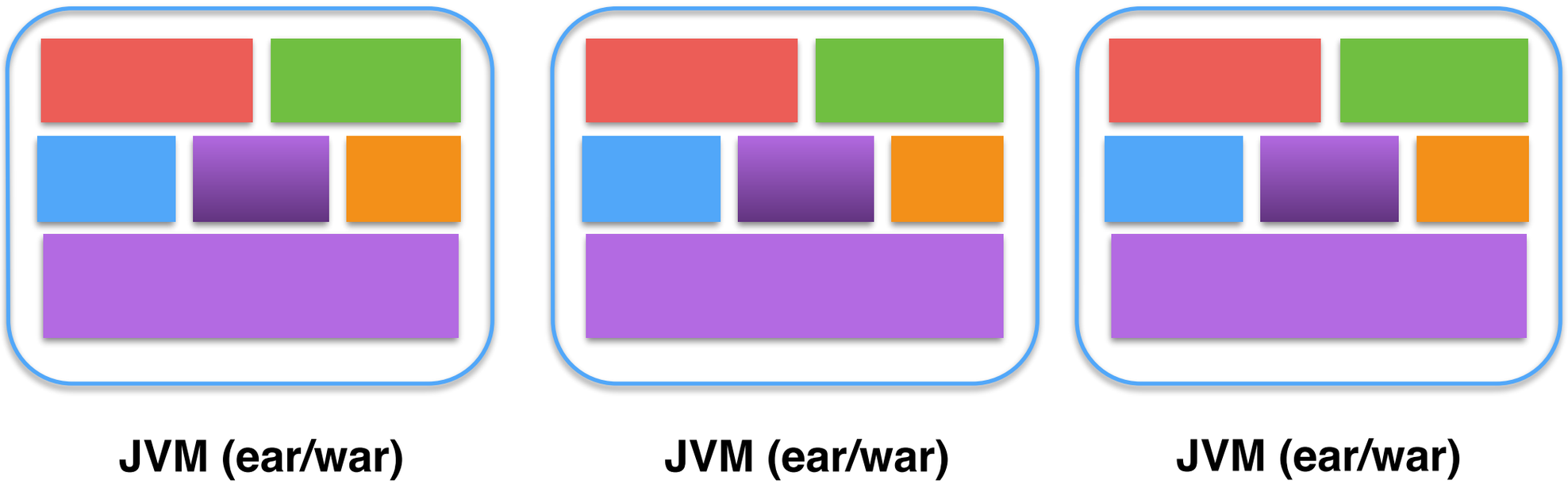
Scaling (Monolith)



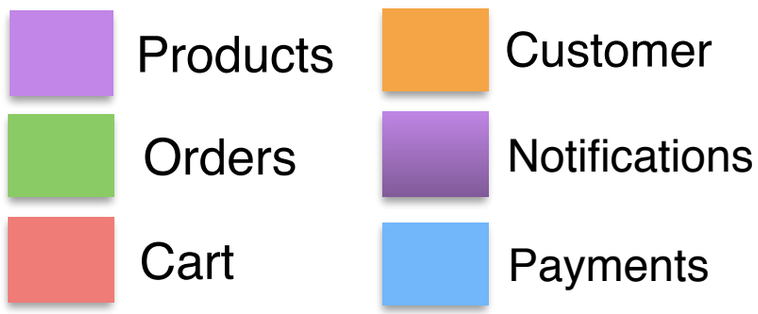
JVM (ear/war)



Scaling (Monolith)



JVM (ear/war) **JVM (ear/war)** **JVM (ear/war)**



Scaling (Micro services)

Products
Customer
Orders
Notifications
Cart
Payments

HTML

HTML / HTTP

Customer

x2

Products

Notifications

Store Front

API Gateway

Cart

x2

Payments

REST / HTTP

Orders

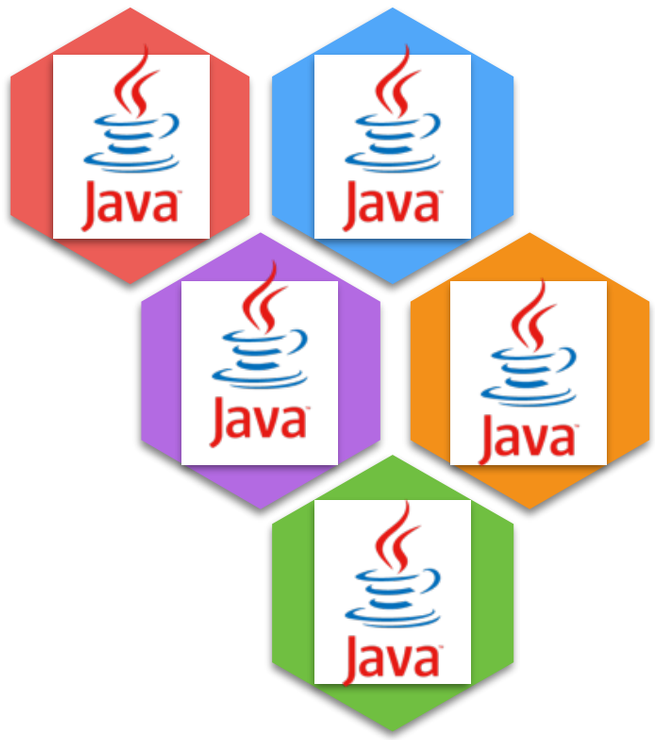
x3

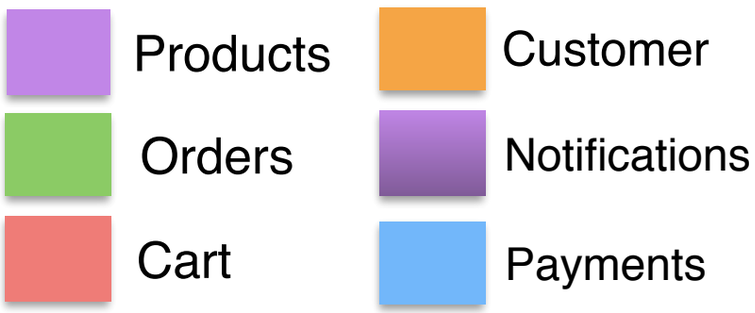
AMQP

Languages & Technology

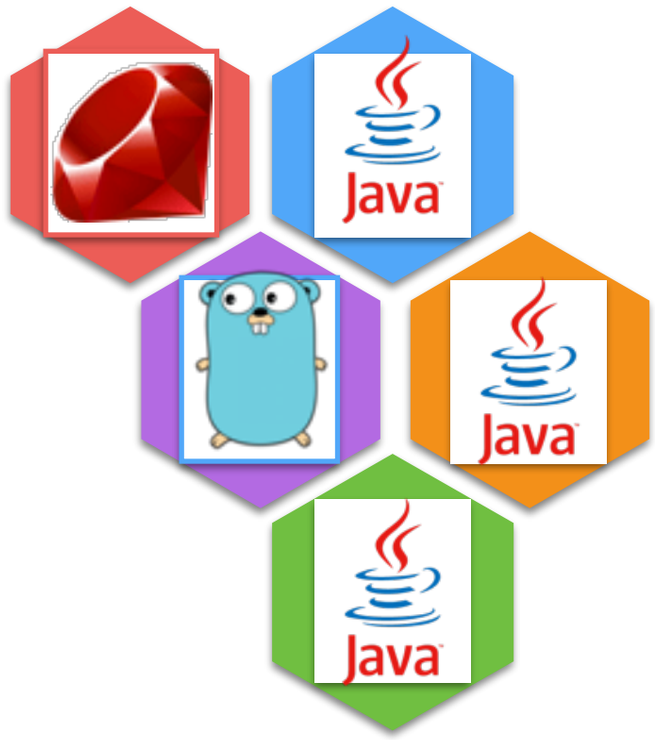
Products
Orders
Cart
Customer
Notifications
Payments

Languages & Technology

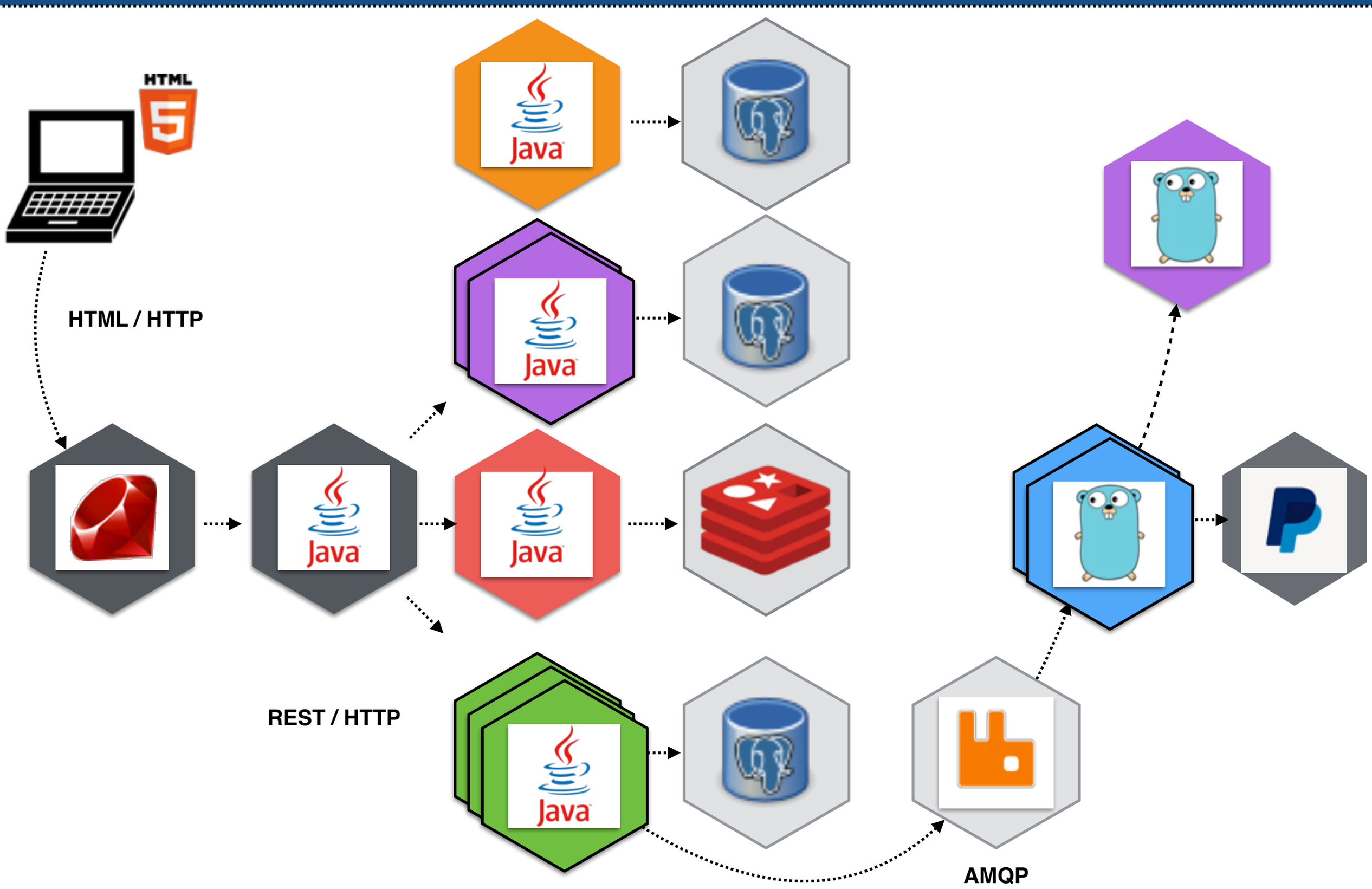




Languages & Technology



Products
Orders
Cart
Customer
Notifications
Payments


HTML
HTML / HTTP
Java
Java
Java
Java
Java
REST / HTTP
AMQP

Key principles when implementing Micro Services

Example App

using

Micro Services

STUFF!

(0) Items Checkout

Breaking Bad S2 $19.99

Walter White, a struggling high school chemistry teacher, is diagnosed with advanced lung cancer.

★★★★☆ 10 reviews

Add to Cart

Mr. Robot S1 $21.99

The show follows Elliot, who is a cyber-security tech by day and vigilante hacker by night.

★★★★☆ 5 reviews

Add to Cart

Fight Club $16.99

A ticking-time-bomb insomniac and a slippery soap salesman channel primal male aggression into a shocking new form of

★★★★★ 2 reviews

Add to Cart

STUFF!

(0) Items Checkout

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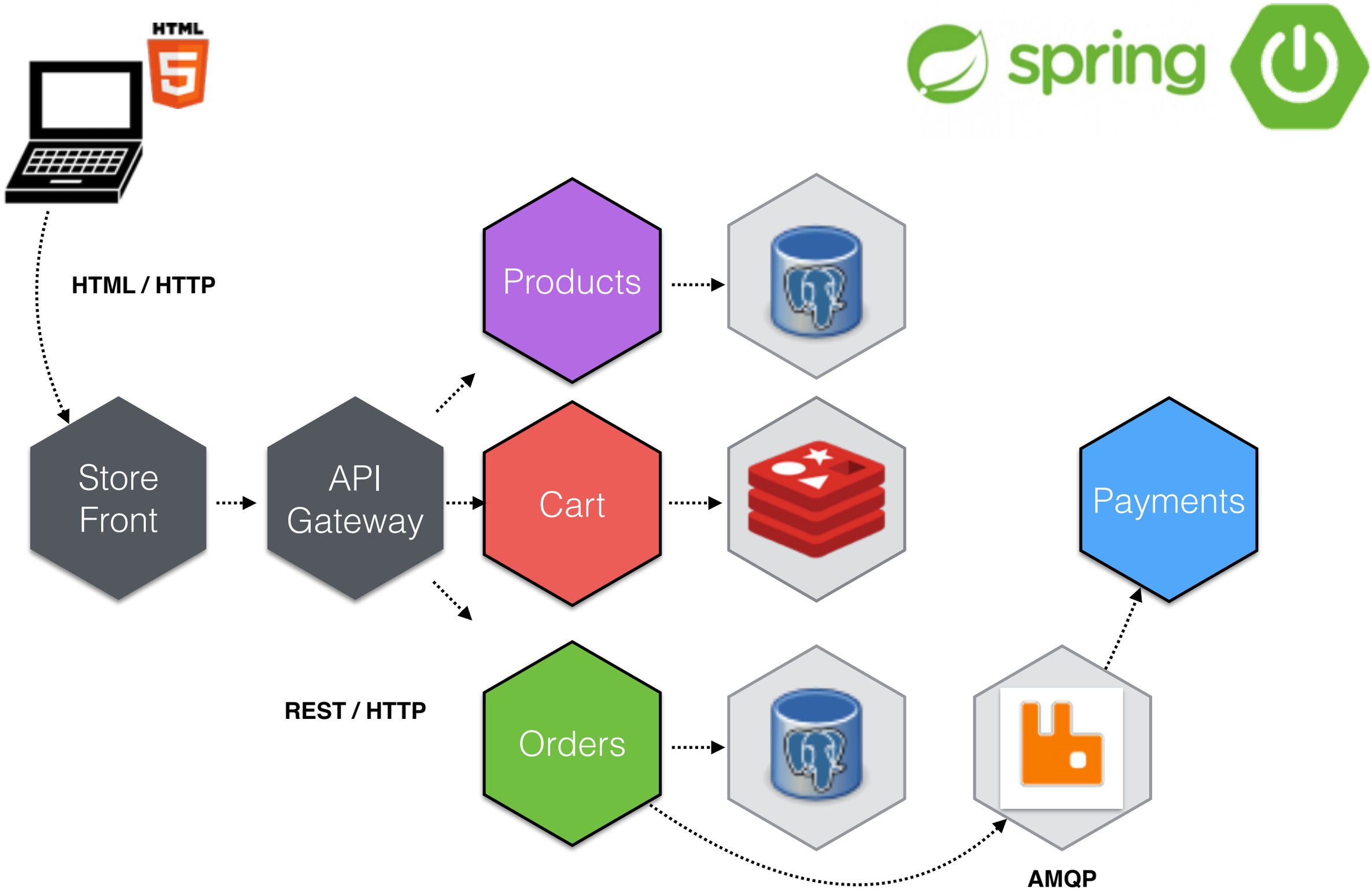
Orders


HTML
HTML / HTTP
Products
Store Front
API Gateway
Cart
Payments
REST / HTTP
Orders
AMQP

java -jar <app>.jar

One Codebase

per

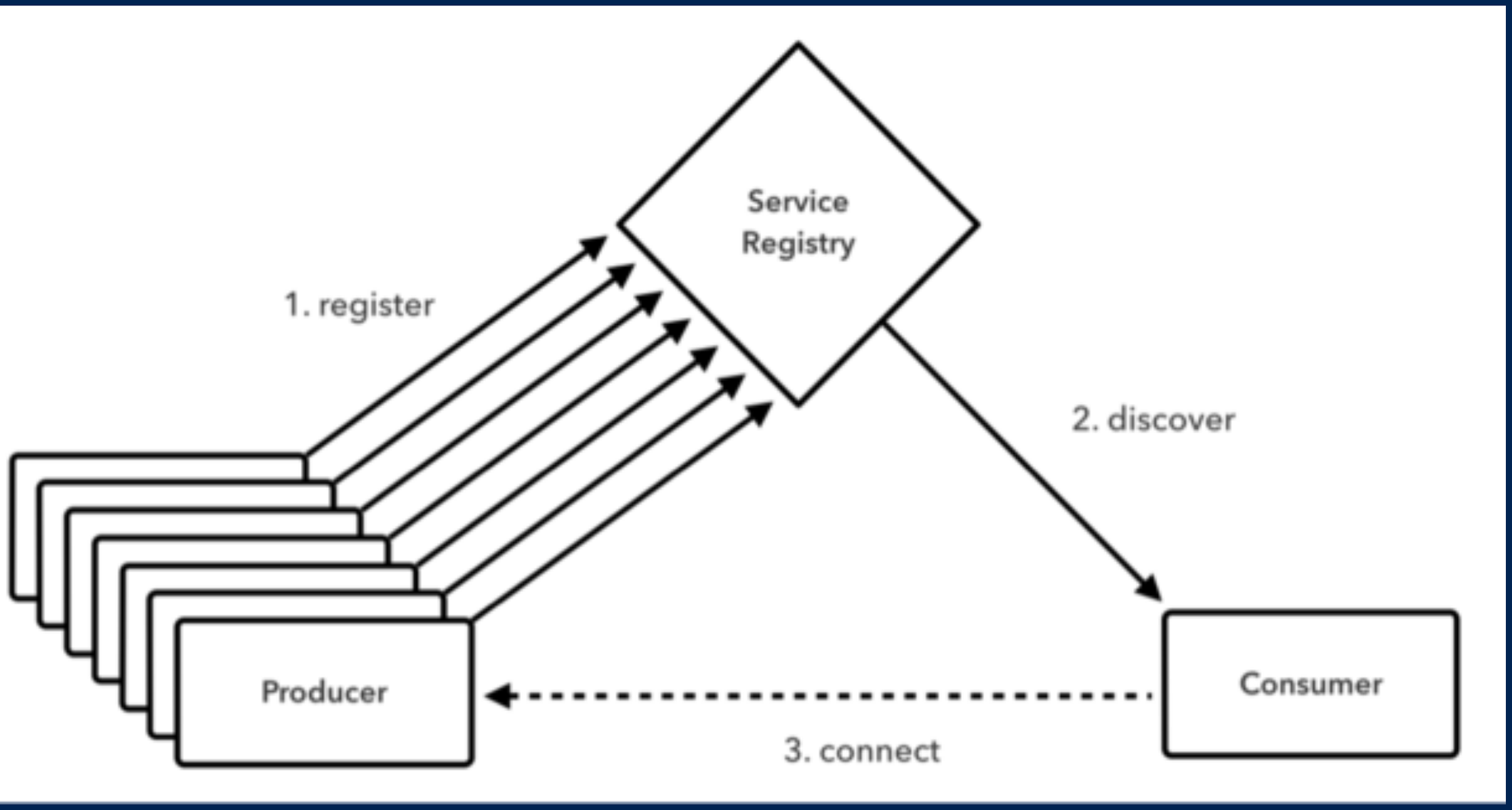
Micro Service

Service Registry

&

Discovery

Service Registry & Discovery



http://docs.pivotal.io/spring-cloud-services/service-registry/index.html

Service Registry (Eureka)

Instances currently registered with Eureka

Application	AMIs	Availability Zones	Status
STUFF-CART	n/a (1)	(1)	UP (1) - 9.80.81.186
STUFF-ORDERS	n/a (1)	(1)	UP (1) - 9.80.81.186
STUFF-PRODUCTS	n/a (1)	(1)	UP (1) - 9.80.81.186
STUFF-STORE-GATEWAY	n/a (1)	(1)	UP (1) - 9.80.81.186

Service Registry

```
public ResponseEntity getProducts() {
    ParameterizedTypeReference<Resource> responseType =

    // use the "smart" Eureka-aware RestTemplate
    ResponseEntity exchange =
        this.restTemplate.exchange(
                "http://stuff-products/products",
                HttpMethod.GET,
                null,
                responseType);
```

Service Registry (DNS)

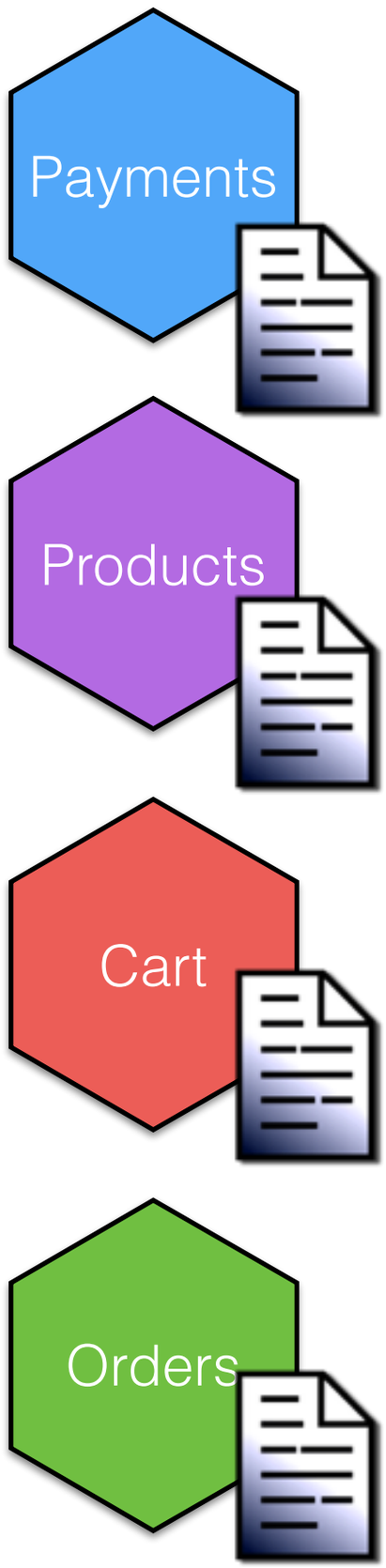
```
~(master ✓) $ cf apps
Getting apps in org stgodard@ca.ibm.com / space demo as stgodard@ca.ibm.com...
OK

name                 requested state   instances   memory   disk   urls
cart                 started           1/1         256M     1G     stuff-cart.mybluemix.net
orders               started           1/1         256M     1G     stuff-orders.mybluemix.net
products             started           1/1         256M     1G     stuff-products.mybluemix.net
service-registry     started           1/1         256M     1G     stuff-eureka.mybluemix.net
store-api-gateway    started           1/1         256M     1G     stuff-api-gateway.mybluemix.net
storefront           started           1/1         256M     1G     stuff-store.mybluemix.net
~(master ✓) $
```

Service Registry (DNS)

App Name	Runtime	Health
cart http://stuff-cart.mybluemix.net	Liberty for Java™	Running
orders http://stuff-orders.mybluemix.net	Liberty for Java™	Running
products http://stuff-products.mybluemix.net	Liberty for Java™	Running
service-registry http://stuff-eureka.mybluemix.net	Liberty for Java™	Running
store-api-gateway http://stuff-api-gateway.mybluemix.n	Liberty for Java™	Running
storefront http://stuff-store.mybluemix.net	SDK for Node.js™	Running

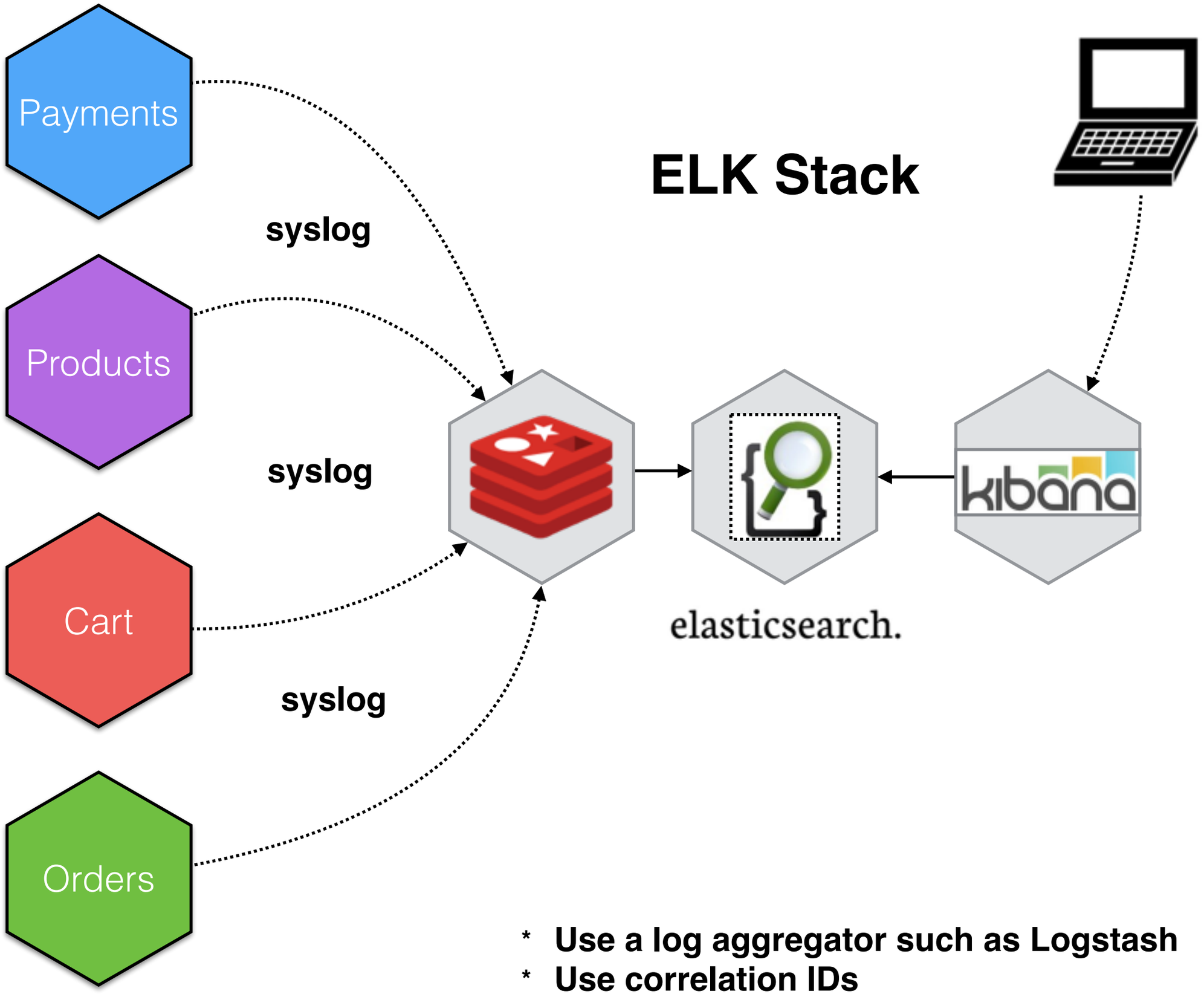
Treat logs as Event Streams

** use centralized logging / aggregation*



Logs

- multiple microservices
- potentially multiple instances of services
- containers in cloud platforms are ephemeral
- Don’t log to disk in a cloud platform



* **Use a log aggregator such as Logstash**
* **Use correlation IDs**

Design for Failure

** use Circuit Breaker pattern*

Circuit Breaker

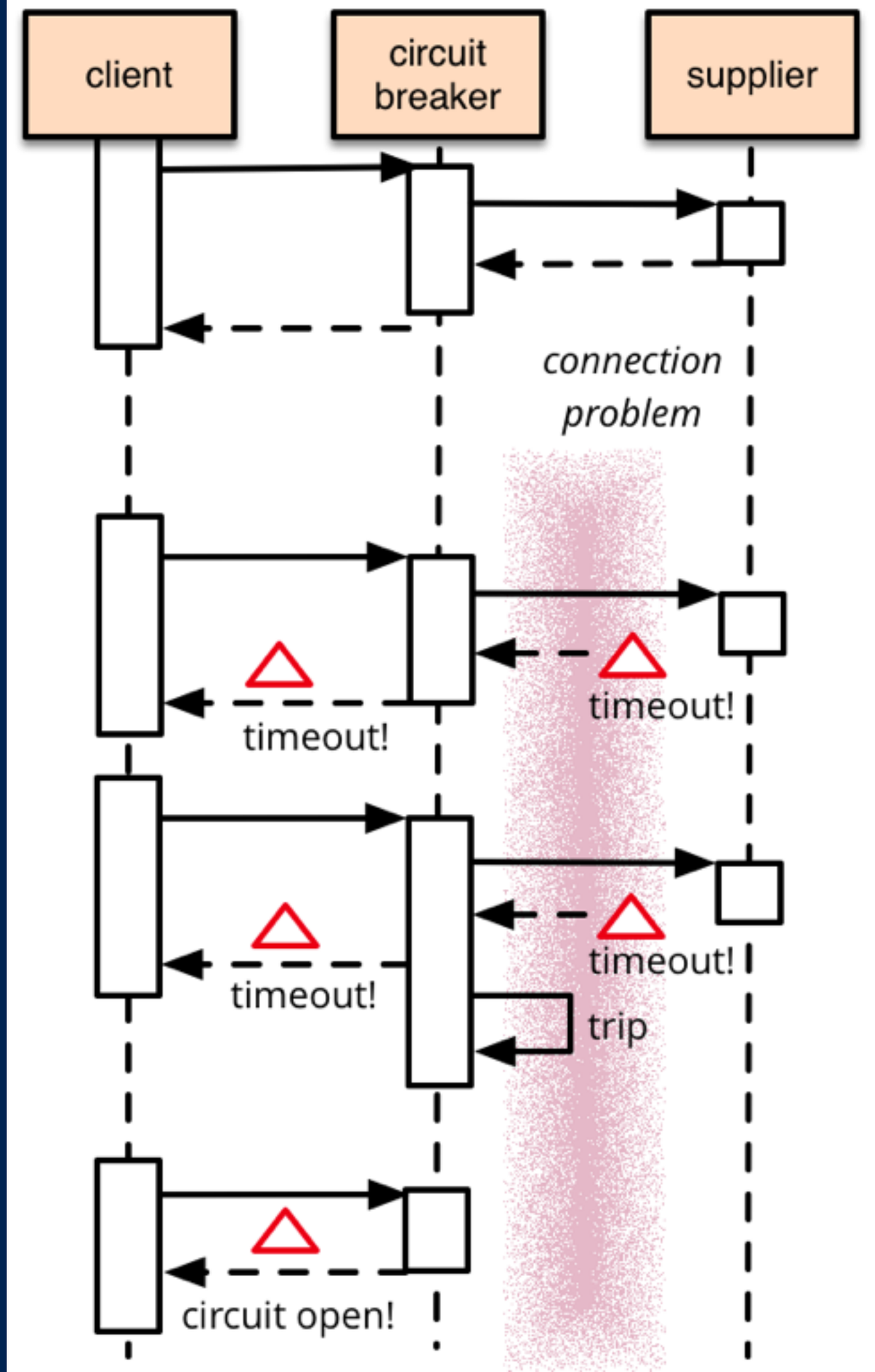
- wrap calls to services, monitor for failure

- if failures reach threshold, circuit breaker “trips”

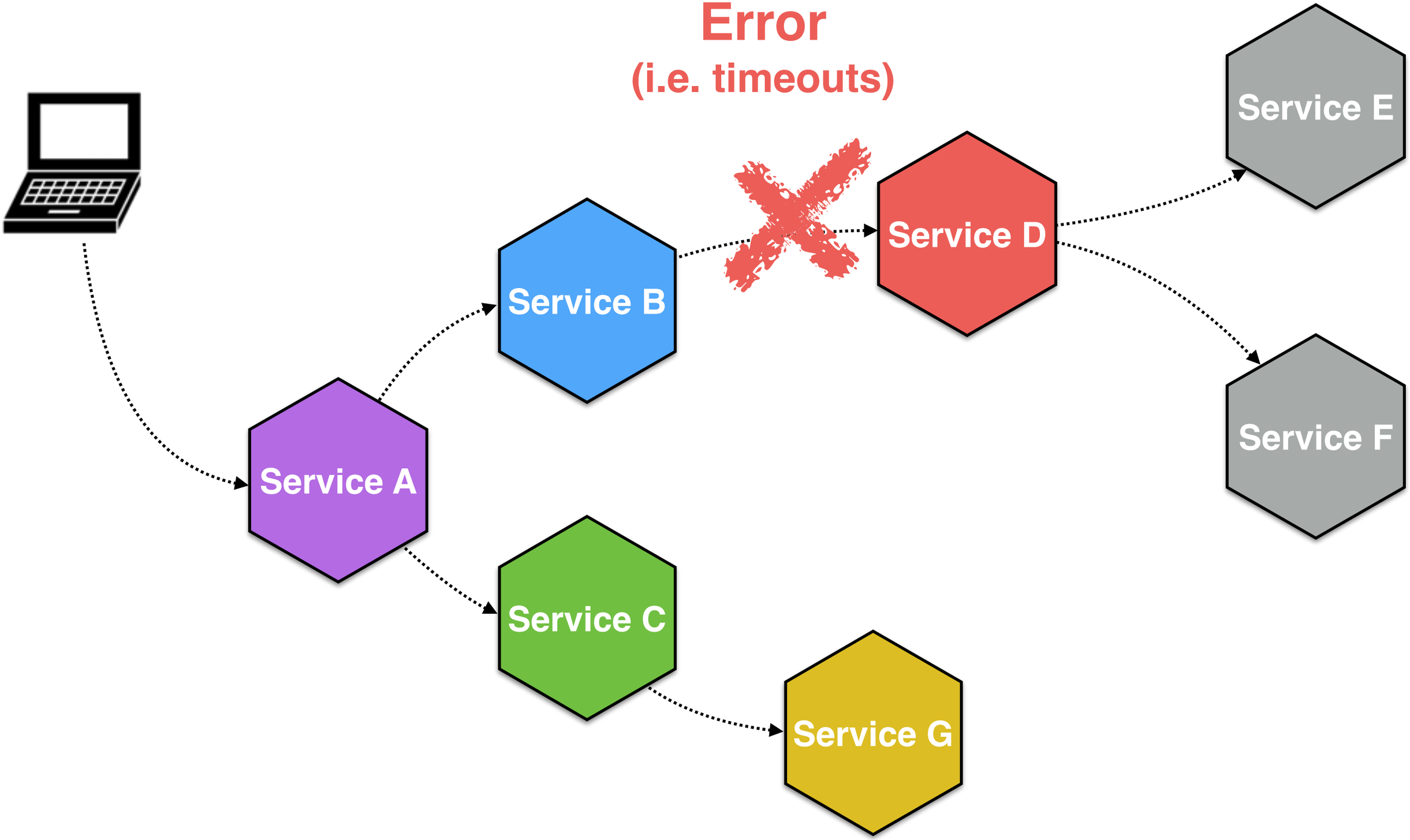
- subsequent calls return err or “fallback” behavior

- circuit checks when service becomes available

http://martinfowler.com/bliki/CircuitBreaker.html



Error
(i.e. timeouts)

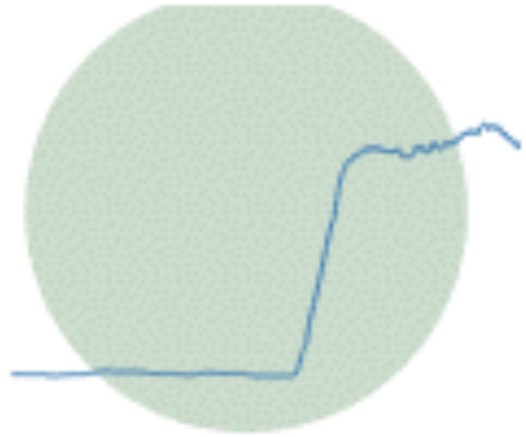


Circuit Breaker

```
@Component
public class ProductsClient {

    @Autowired
    private RestTemplate restTemplate;

    @HystrixCommand(fallbackMethod = "defaultProducts")
    public ResponseEntity getProducts() {
        ParameterizedTypeReference<Resource> responseType = new ParameterizedTyp

        ResponseEntity exchange =
                this.restTemplate.exchange(
                        "http://stuff-products/products",
                        HttpMethod.GET,
                        null,
                        responseType);
        return exchange;
    }

    public ResponseEntity defaultProducts(){
        ResponseEntity resp = new ResponseEntity(HttpStatus.SERVICE_UNAVAILABLE)
        return resp;
    }
```

Circuit Breaker (Hystrix)

Circuit Sort: Error then Volume | Alphabetical | Volume | Error | Mean | Median | 90 | 99 | 99.



getProducts

583	0	0.0 %
0	0	
	0	

Host: 58.3/s
Cluster: 58.3/s
Circuit Closed

Hosts	1	90th	17ms
Median	14ms	99th	28ms
Mean	14ms	99.5th	30ms

getCart

0	0	0.0 %
0	0	
	0	

Host: 0.0/s
Cluster: 0.0/s
Circuit Closed

Hosts	1	90th	0ms
Median	0ms	99th	0ms
Mean	0ms	99.5th	0ms

Thread Pools

Sort: Alphabetical | Volume |

ProductsClient

Host: 55.5/s
Cluster: 55.5/s

Active	1	Max Active	1
Queued	0	Executions	555
Pool Size	10	Queue Size	5

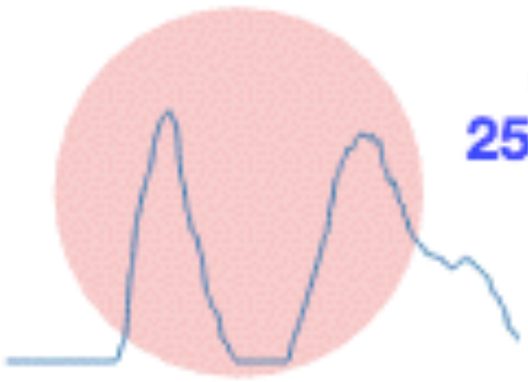
CartClient

Host: 0.0/s
Cluster: 0.0/s

Active	0	Max Active	0
Queued	0	Executions	0
Pool Size	10	Queue Size	5

Circuit Breaker (Hystrix)

Circuit Sort: Error then Volume | Alphabetical | Volume | Error | Mean | Median | 90 | 99 | 99.5



getProducts

0	0	100.0 %
252	0	
	0	

Host: **38.5/s**
Cluster: **38.5/s**
Circuit Open

Hosts	1	90th	0ms
Median	0ms	99th	0ms
Mean	0ms	99.5th	0ms

getCart

0	0	0.0 %
0	0	
	0	

Host: **0.0/s**
Cluster: **0.0/s**
Circuit Closed

Hosts	1	90th	0ms
Median	0ms	99th	0ms
Mean	0ms	99.5th	0ms

Thread Pools

Sort: Alphabetical | Volume |

ProductsClient

Host: **0.0/s**
Cluster: **0.0/s**

Active	0	Max Active	0
Queued	0	Executions	0
Pool Size	10	Queue Size	5

CartClient

Host: **0.0/s**
Cluster: **0.0/s**

Active	0	Max Active	0
Queued	0	Executions	0
Pool Size	10	Queue Size	5

Circuit Breaker

- deal with latency and failures
- builds resiliency into your application
- avoid cascading failures
- Hystrix Dashboard provides a view of endpoints and monitor failures

https://github.com/Netflix/Hystrix

Scale the App via Process Model

Scaling Microservices

$ cf push <app>

```
name                requested state   instances   memory   disk   urls
cart                started           1/1         256M     1G     stuff-cart.mybluemix.net
orders              started           1/1         256M     1G     stuff-orders.mybluemix.net
products            started           1/1         256M     1G     stuff-products.mybluemix.net
service-registry    started           1/1         256M     1G     stuff-eureka.mybluemix.net
store-api-gateway   started           1/1         256M     1G     stuff-api-gateway.mybluemix.net
storefront          started           1/1         256M     1G     stuff-store.mybluemix.net
```

Scaling Microservices

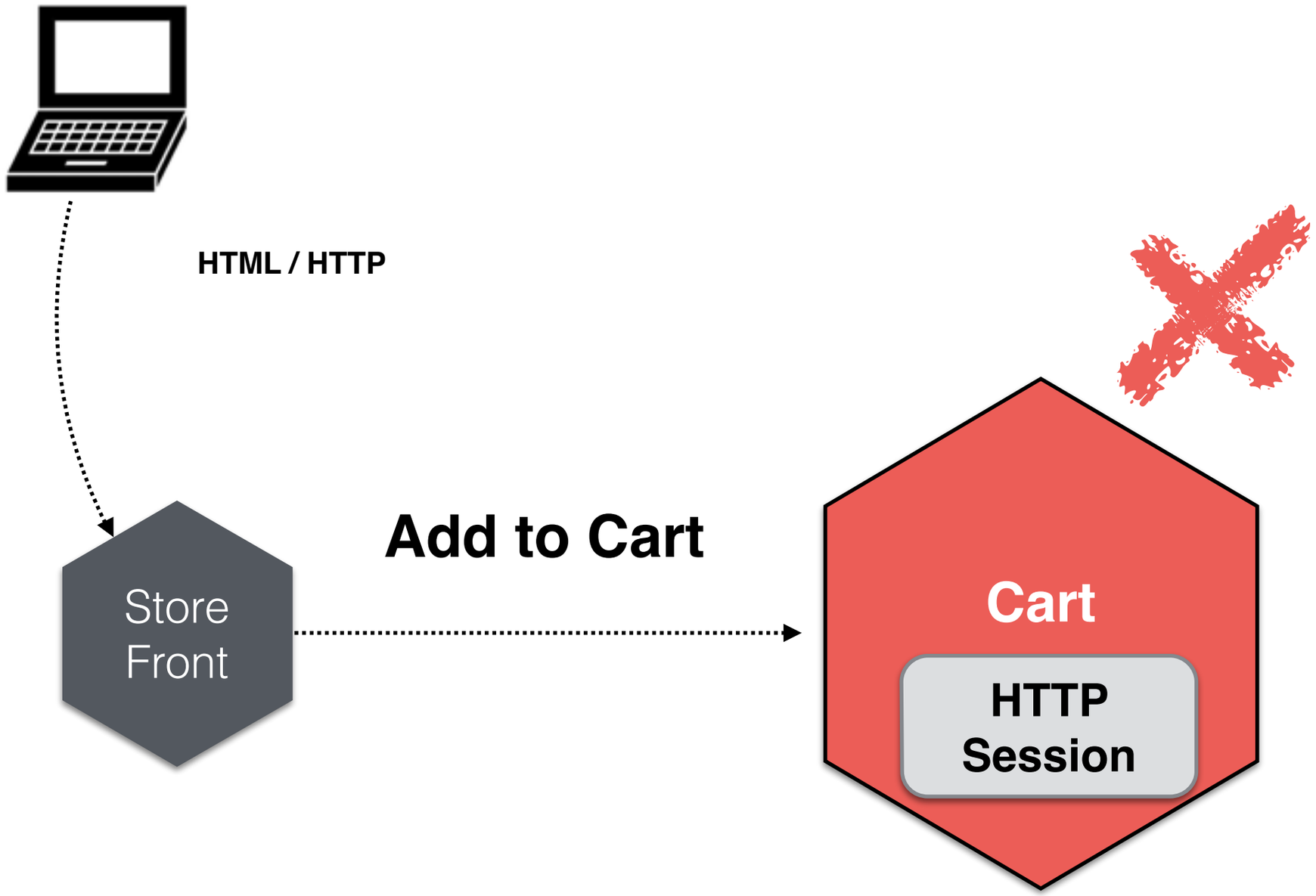
$ cf scale <app> -i 2

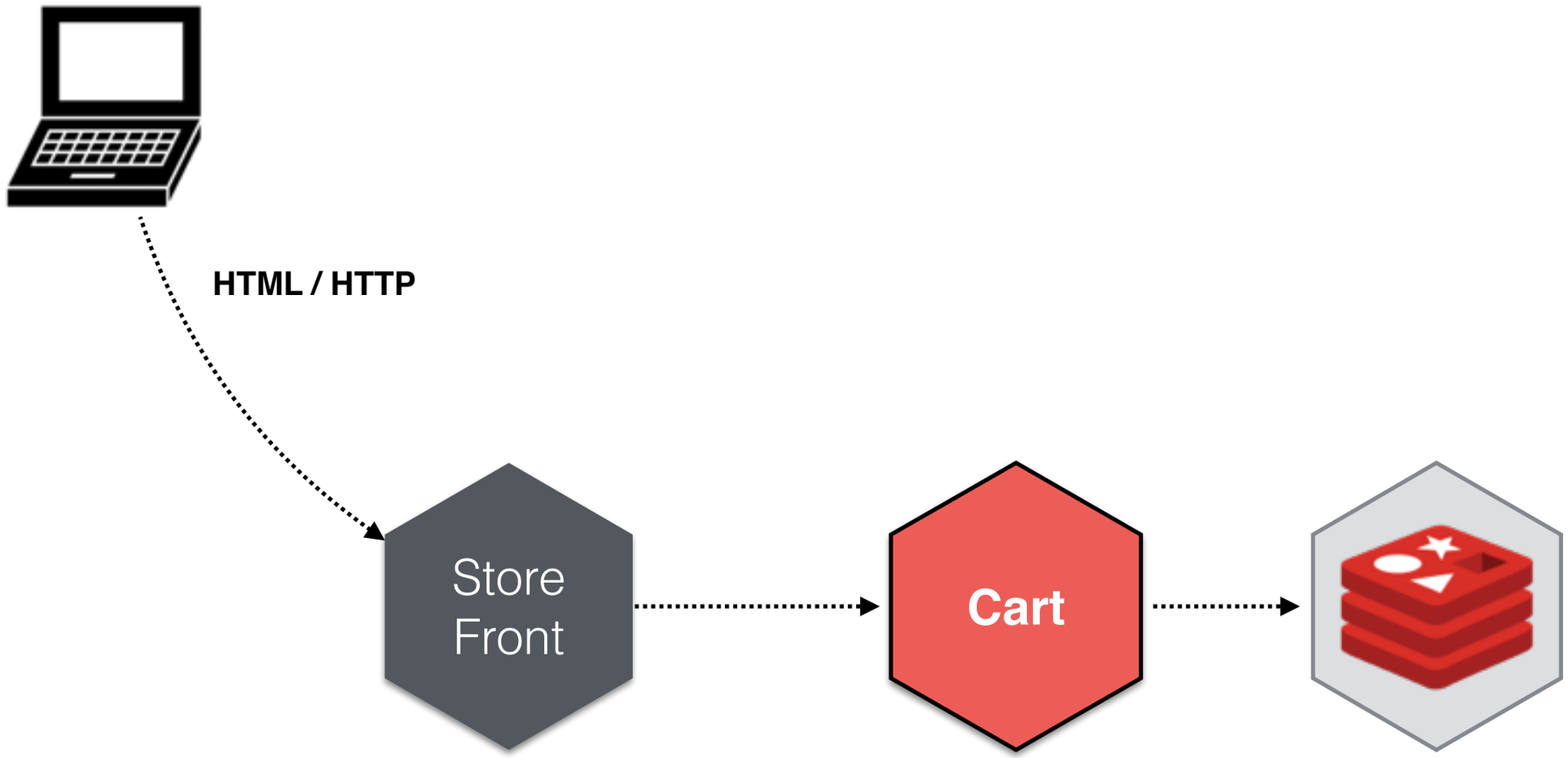
```
~/Development/microservice-demo/products(master ✓) $ cf scale products -i 2
Scaling app products in org stgodard@ca.ibm.com / space demo as stgodard@ca.ibm.com...
OK
~/Development/microservice-demo/products(master ✓) $ cf a
Getting apps in org stgodard@ca.ibm.com / space demo as stgodard@ca.ibm.com...
OK

name                requested state   instances   memory   disk   urls
cart                started           1/1         256M     1G     stuff-cart.mybluemix.net
orders              started           1/1         256M     1G     stuff-orders.mybluemix.net
products            started           2/2         256M     1G     stuff-products.mybluemix.net
service-registry    started           1/1         256M     1G     stuff-eureka.mybluemix.net
store-api-gateway   started           1/1         256M     1G     stuff-api-gateway.mybluemix.net
storefront          started           1/1         256M     1G     stuff-store.mybluemix.net
~/Development/microservice-demo/products(master ✓) $
```

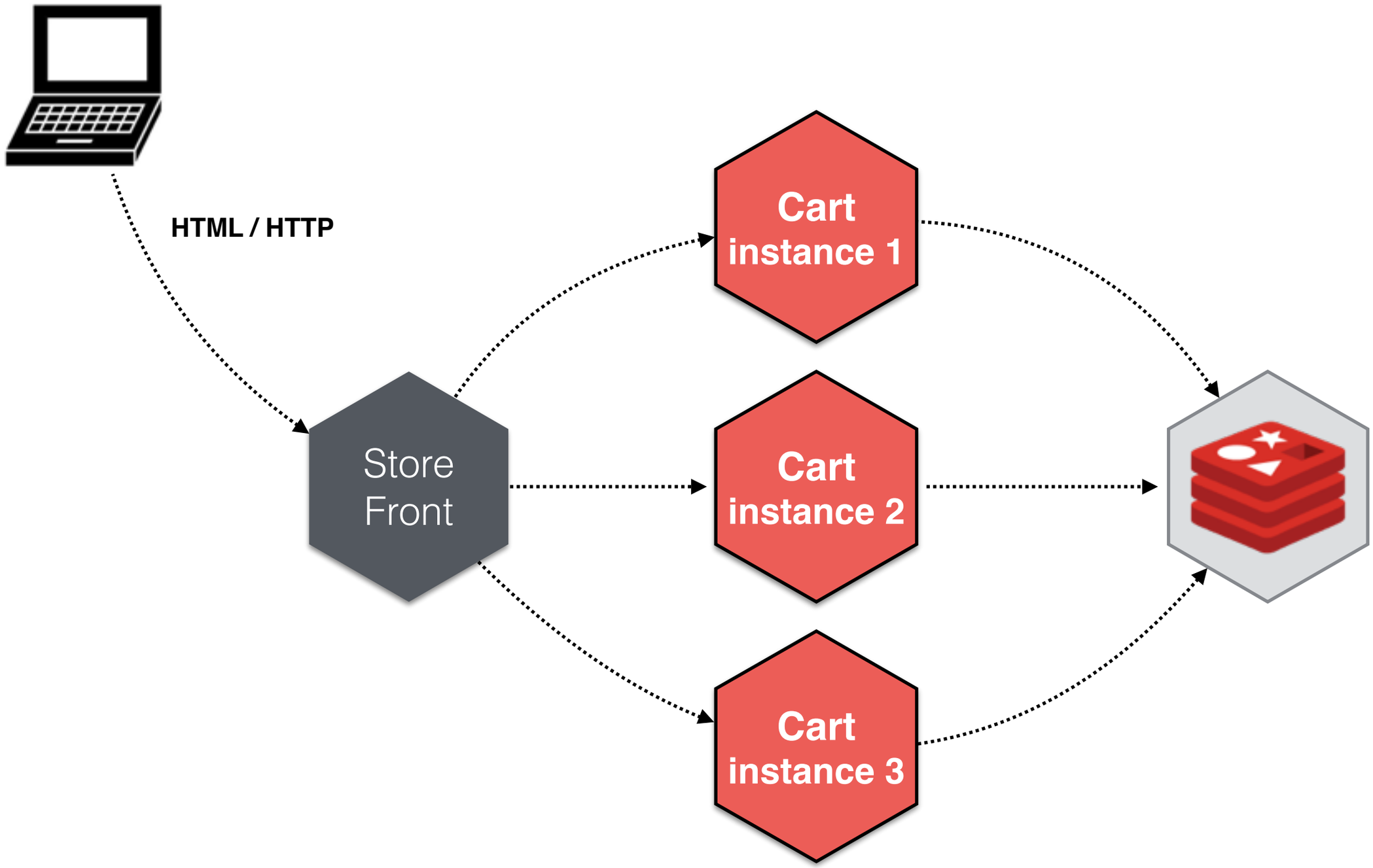
Stateless

Processes

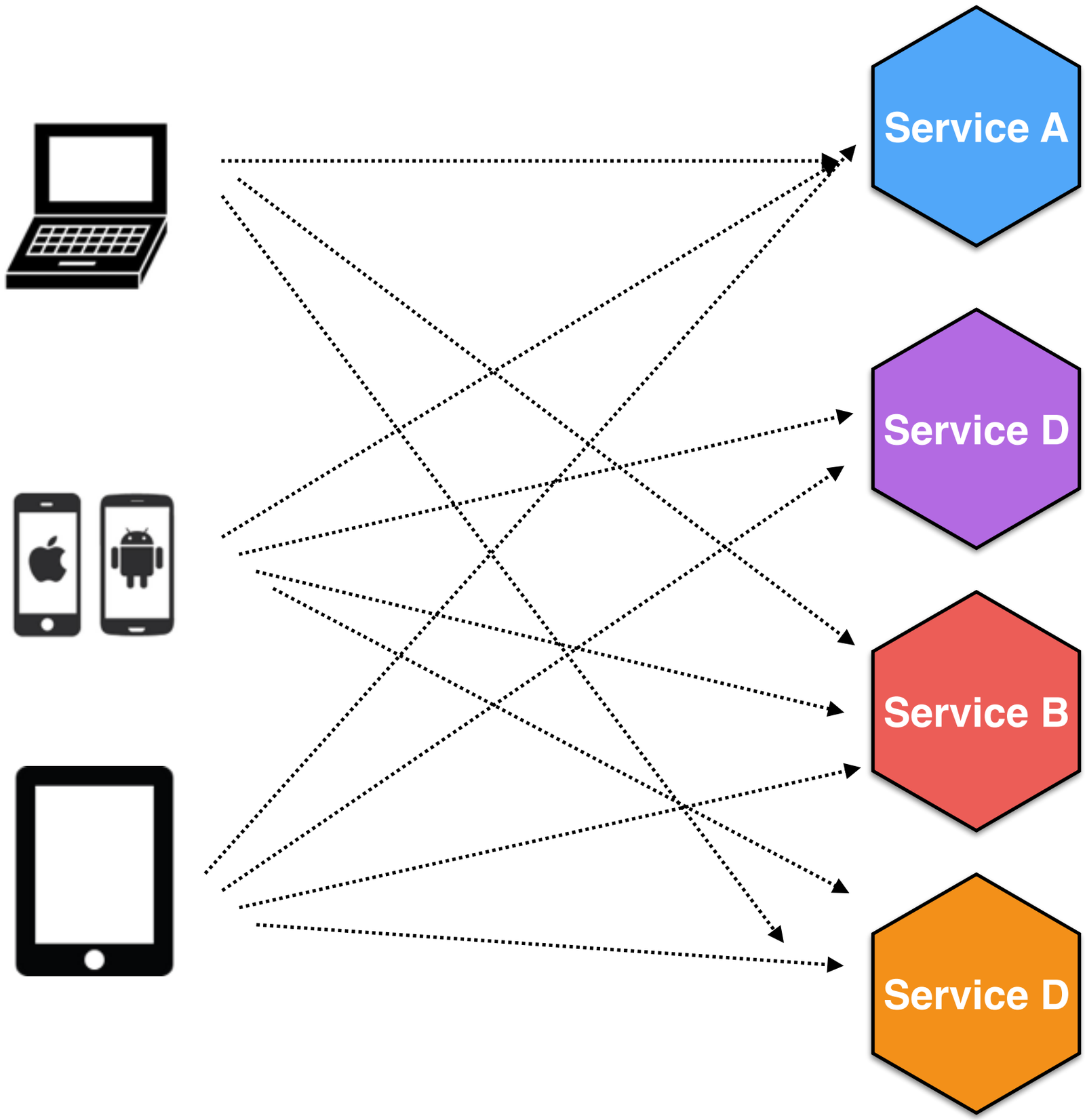
** store state in distributed shared storage*

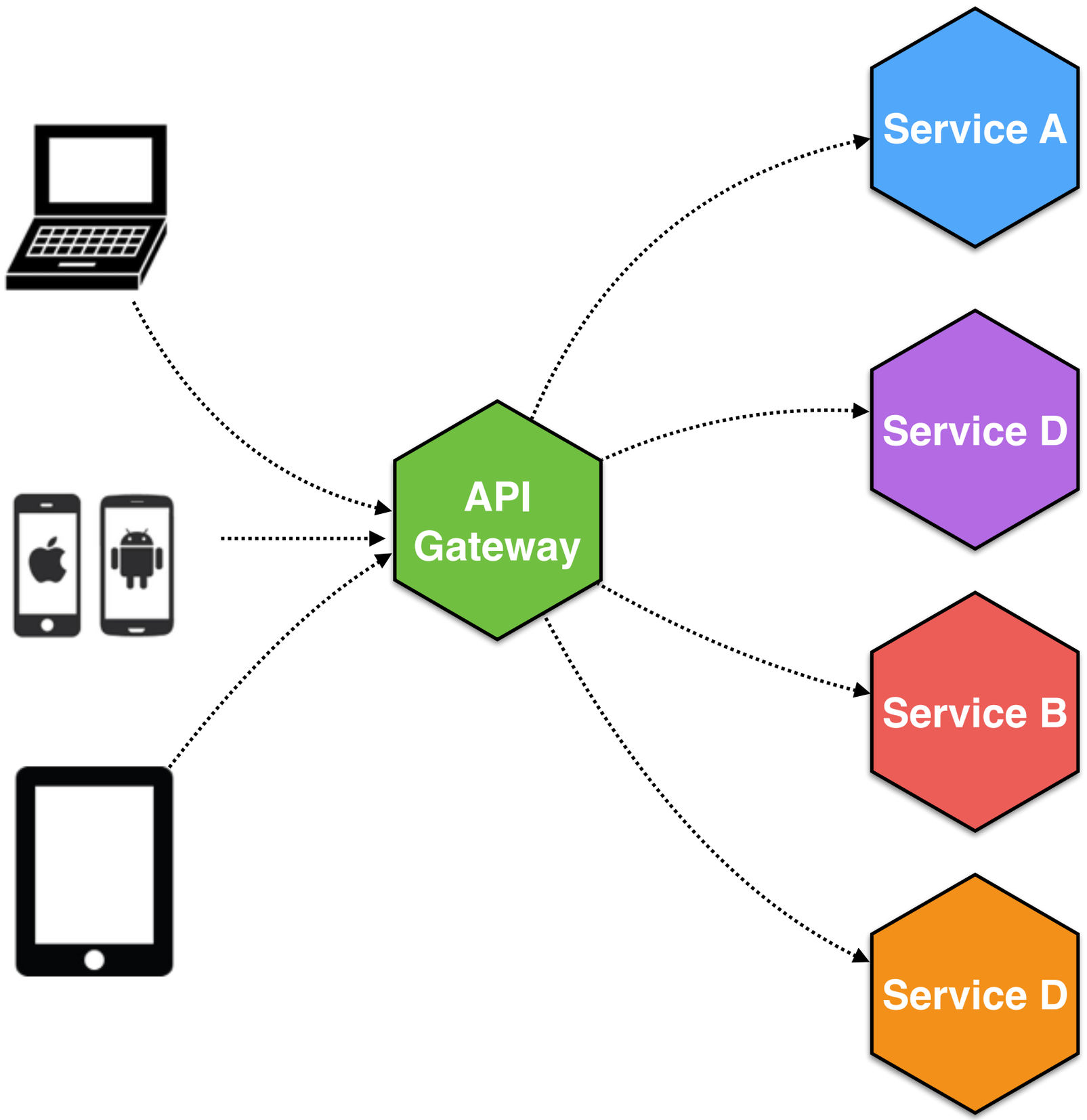

HTML / HTTP
Add to Cart
Store Front
Cart
HTTP Session


HTML / HTTP
Store Front
Cart


HTML / HTTP
Store Front
Cart instance 1
Cart instance 2
Cart instance 3

API Gateway


Service A
Service D
Service B
Service D


Service A
API Gateway
Service D
Service B
Service D

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For more info on key practices for building apps that run “as a service”

Microservices

- Don’t start with micro services
- Distribution Complexity
  - Logging, monitoring, decentralization

- Requires a culture of automation
  - automated testing (CI)
  - automated deployments (CD)
  - rapid provisioning

- Team structure / organizational change
- Avoid creating too many micro services

Microservices

- Loosely coupled
- Independently deployable
- Single code base per micro service
  - smaller teams
  - quicker app startup times / productivity
- Easier to
  - scale specific workloads
  - move to new technology
  - replace a micro service
- Smaller / more frequent releases
  - Continuous Delivery

References

- **Microservices:**
  - http://martinfowler.com/microservices.html
- **Spring Boot / Cloud Netflix**
  - http://projects.spring.io/spring-boot/
  - http://cloud.spring.io/spring-cloud-netflix/

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Thanks

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